REPORT

ON

THE PROGRESS

OF

HUMAN ANATOMY AND PHYSIOLOGY

In the Year 1844-5

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THE following Report concerns the history of physiology during a longer period than either of the two former Reports, and contains notices of the works published between the 1st of October 1844, and the 31st of December 1845. Its general plan is similar to that of those already published, except in that, for brevity's sake and for convenience of reference, there are appended to each chief section the titles of such essays relating to the subject therein treated of as, for various reasons, could not or needed not to receive any further notice. For this, as for all the former Reports, the original essays have been read in nearly every instance; and whenever reference is made in the foot-notes to more than one publication as containing the facts to which any part of the Report relates, the first of the books so referred to is that from which the account given in the text was derived.

CHEMICAL COMPOSITION OF THE BODY.

Elementary constituents. Another fact in evidence that copper may occasionally exist, independent of poisoning, in the body, is furnished by Bertozzi,[*] who has detected it in fourteen biliary calculi of various kinds. The more yellow biliary colouring matter they contained the more abundant was the copper: white biliary calculi contained no trace of it. In bile he never could detect it. But, though these may be facts, yet the question, whether either copper or lead ever exists in the healthy body, must still be held open: in the last year MM. Devergie, Barse,[†] and others have again asserted that they do thus exist, and MM. Flandin and Danger[‡] have as positively again denied it.

Proteine compounds:—Albumen, &c. M. Wurtz[§] has rendered a further account of his mode of preparing albumen, in a state of purity, yet soluble without the addition of alkali or any other of the substances hitherto supposed necessary to its solution.

Dr. Ludwig[||] has extracted from the materials hitherto vaguely named *Extractive matters* of the blood a principle which is isomeric with the binoxyde

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[*] Oesterr. Med. Wochenschr. Sept. 6, 1845.   [†] Comptes Rendus, 28 Oct. 1844.
[‡] Comptes Rendus, 30 Sept. 1844.   [§] Annales de Chimie et de Physique, Nov. 1844.
[||] Annalen der Chemie und Pharmacie, Oct. 1845.

of proteine of Mulder. The extractive is obtained by the pressing of defibrinated and coagulated blood, the neutralizing of the fluid pressed out, and again coagulating it, and filtering. To this filtered fluid, now free from albumen, alcohol is added, and the precipitate thus obtained, being washed with water, yields chloride of sodium, phosphate of soda, and a very small quantity of substance like binoxyde of proteine. Boiling alcohol removes fatty matters from it, and ether a crystallizing fat. The body thus purified, both in its general characters and in the results of its chemical analysis, resembles in all essential respects the binoxyde of proteine. It exists in the serum—not in the blood-corpuscles—and, next to the saline constituents, forms the chief part of the extractive matters of the blood of man, and of the dog, ox, sheep, and pig.

But what binoxyde of proteine may be is a question ; for doubts are now cast by Liebig* on the accuracy of Mulder's researches from which he deduced the existence of proteine itself. Liebig finds that the supposed binoyxde [tritoxyde?] of proteine obtained by adding ammonia to the solution of fibrine in dilute hydrochloric acid (the albuminose of M. Bouchardat), contains really all the sulphur which was present in the fibrine. And he finds that, when, as in the process proposed by Mulder, fibrine, albumen, or caseine is dissolved in potass ley, and the solution is neutralized by acetic acid, this solution contains no sulphuret of potassium or other sulphur compound ; but that, if the precipitate formed when the acetic acid is added (and which is the supposed proteine) be dissolved in potass, sulphur may be detected in it by adding sugar of lead to the solution. This precipitate, therefore, Liebig holds, is not proteine ; neither does he find the corresponding precipitate obtained from peas to be free from sulphur ; nor, finally, has he " yet succeeded in producing a non-sulphuretted substance possessing the composition and properties of the so-styled proteine."

Dr. Buchanan† has found the remarkable fact, that the liquid of hydrocele may be coagulated in five or more minutes into a transparent tremulous jelly-like substance, by adding to it a small quantity of the washed clot of blood. The same coagulating property is possessed in a less degree by several other animal substances ; e. g. the buffy coat of blood in minute shreds, or even when dried and pulverized ; the transparent coagulum on a blistered surface ; and, in various much less degrees, by muscle, skin, cellular membrane, spinal marrow, mucus, and pus. He thinks that the coagulant power is chiefly seated in the colourless blood-corpuscles, which exist, together with the insoluble parts of the red corpuscles and some fibrine, in the washed clot ; and with fibrine in the buffy coat ; and in the coagulum from blisters. To these also he ascribes, I think, the usual coagulation of the blood ; the colourless corpuscles inducing the coagulation of the fibrine dissolved in the liquor sanguinis, and thus leaving its other constituents as serum, which is only *defibrinated* liquor sanguinis.

Fibrine. Dr. Polli‡ has confirmed the fact, that when fibrine begins to putrefy in water, albumen is among the substances formed from it. He has also found that if serum be mixed with three or four times its volume of water, and then boiled, the milky fluid which remains, and which contains, according to Boudet, albumen combined with soda, is spontaneously coagulable. If left to itself for a few days it forms an opaque-white soft clot, from which a

* Lancet, Feb. 20, 1845.

† Medical Gazette, Aug 8, 1845. Dr. Buchanan argues as if it were proved that the fluid of hydrocele contains fibrine, and that it is fibrinous coagulation by which it becomes jelly-like when the portions of clot or other substances mentioned are added. It may be so, but there is no proof of it ; and he is not right, I think, in saying that hydrocele fluid is commonly regarded as analogous to liquor sanguinis. The same coagulability may be seen in other dropsical fluids, e. g. when blood is let into them after death. ‡ Annali Univ. di Medicina, Feb. 1845.

limpid watery fluid separates, in which the clot sinks. But the spontaneous coagulation is the only circumstance in which it imitates fibrine, for the clot is not filamentous.

The rest of this paper is occupied with the changes induced in the fibrine of blood by inflammation, especially its diminished tendency to coagulation, and its rarefaction. Several cases of late coagulation are given, similar to that mentioned in the last Report,* but less remarkable than it. They confirm his belief that no blood is really incoagulable or remains liquid out of the body till it decomposes: and that when blood has seemed not coagulable, as in typhus and scurvy, its coagulation has been overlooked, or it has not been kept long enough for an unusually slow coagulation to take place. He considers that the most essential condition of this slowness of coagulation is a peculiar modification of the vitality of the fibrine, other favorable conditions being the excess of carbonic acid and of salts in the blood. And for fibrine thus modified by the influence of an inflammation he proposes the name of *bradyfibrine*.

Fibrine modified in another manner, and peculiarly *rarified*, he calls *parafibrine*. He has found that in the most acute inflammations the specific gravity of the blood or liquor sanguinis is rather increased by the removal of the fibrine; so that, contrary to the rule of health, the serum has a higher specific gravity than the liquor sanguinis. He supposes that this light fibrine, or parafibrine, may be that which is formed during, and as a result of, the inflammation, and which, in severe cases, may be formed in such quantity that it more than balances the effect of the ordinary fibrine and the *bradyfibrine* in increasing the specific gravity of the blood, so that the specific gravity of the blood is increased when both it and they are removed from it. He describes the parafibrine as coagulating very slowly into a mass which has a gelatinous aspect, and consists of very slender filaments, like those which give consistence to the albumen of an egg. When the serum is pressed from such a clot it becomes fibrous, tenacious, and heavier than the serum. Such clots are found in vesications : the fluid they contain is rich in parafibrine, and may be studied for the characters of this substance.

Both these modifications of fibrine may coexist in various proportions with ordinary fibrine in inflammatory blood, and hence arise many varieties in the time of coagulation and the appearance of the buffy coat of such blood. It is this light fibrine in the blood in inflammations, which, according to Dr. Polli, is effused with the serum in inflamed parts, for its tenuity permits it to traverse the walls of the vessels more easily than any other constituent of the blood can ; and, once effused, it coagulates and becomes fibrous. Its copious existence in blood indicates the highest degree of inflammation ; of this the gelatiniform buffy coat is the best sign. The simply retarded coagulation, due (at least in part) to the formation of bradyfibrine, indicates a lower degree of inflammation. The mere increase of ordinary fibrine is characteristic of the first degree of the same, and the increase of the one is proportionate to the extent of the other. Lastly, the existence of light fibrine in blood explains how a buffy coat may in certain stages of inflammations be formed in blood which coagulates quickly. In such a case the liquor sanguinis is very light, and may have been made lighter by previous bleedings ; the corpuscles sink rapidly and leave above a layer which may presently form the buffy coat.

Saline constituents of animal fluids. Dr. Golding Bird† questions the correctness of Enderlin's‡ deduction that no organic acid is combined with the alkaline bases of any of the secretions except the bile, because no alkaline carbonate is found in any of their ashes. He thus shows that a salt of soda

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with an organic acid may exist in a solution of phosphate of soda, and yet yield no carbonate on ignition ;—nine grains of dry tribasic phosphate of soda being mixed with four grains of acetate of soda, and exposed to a full red heat in a covered crucible, the product is easily soluble in water, and has a strong alkaline reaction ; but no effervescence ensues on adding dilute sulphuric acid to it.*

BLOOD.

Corpuscles. Mr. Gulliver† has published a synopsis of all his former observations on the sizes of the red corpuscles of the vertebrata, in tables, stating the measurements of these bodies in no less than 485 species. He has also shown,‡ in reference to the formation of the buffy coat, that the rapidity of sinking of the blood corpuscles is not directly proportionate to the tenuity of the fluid in which they are collected, but rather, inversely proportionate ; for it depends mainly on the rapidity and completeness with which they aggregate in rolls and clusters (as described by Hewson and others). This grouping is promoted by saline solutions, which have been made thicker by mixing gummy matters with them, and is retarded or destroyed by dilute saline solutions. As soon as the corpuscles are aggregated they begin to sink rapidly ; and hence, in blood that will be buffed, there is a remarkable acceleration of the sinking of the corpuscles two or three minutes after it is drawn.

Blood. Dr. G. O. Rees,§ extending his well-known observations on the changes produced in the blood corpuscles by the entrance of fluid when they are placed in fluids of less specific gravity than the liquor sanguinis, and by the exit of fluid from them when placed in fluids of higher specific gravity than their fluid contents, has shown in these changes several sources of fallacy in the quantitative analyses of the blood. He states also that, after copious perspiration induced by exercise, the corpuscles are thin and very like those from which fluid has exuded when immersed in a denser fluid. The change may be ascribed to the loss of water from the liquor sanguinis, and the consequent increase of its density, till it becomes of higher specific gravity than the fluid contents of the blood-corpuscles. On the other hand, the serum of a dog, into whose veins six ounces of water were injected in the place of six ounces of blood just previously drawn, was tinged by the colouring matter of the corpuscles, which had oozed from them into the fluid of reduced specific gravity.|| In examining corpuscles retained at a temperature of 100° F., he has seen each corpuscle contracting into a hour-glass form, and then dividing into two, usually of unequal size, a process which he supposes to be similar to that by which the corpuscles are naturally multiplied.

Gaseous contents. Prof. Magnus¶ has repeated his experiments to determine the quantities of oxygen and nitrogen contained in the blood, and the extreme quantities of those gases which it is capable of absorbing. The ex-

* Among other works relating to animal chemistry in general, the most important are, of course, the Lectures of Liebig in the Lancet of the past year, and the continuation of Mulder's Physiol. Scheikunde ; and after these,—1. An essay by Dr. Schmidt, ' Zur vergleichende Physiologie der wirbellosen Thiere,' in the Annalen der Chemie, Juni 1845 ; from an essay published at Brunswick. Its main purpose is to obliterate the supposed line of absolute material distinction between the animal and vegetable kingdoms, evidence being drawn from ample analyses of the elementary tissues of the invertebrata. 2. Gobley, " Sur l'existence des acides oléique, margarique, et phospho-glycérique dans le jaune d'œuf," in the Comptes Rendus, Sept. 29, and Nov. 3, 1845. I may here also refer for the compendium of every recent work on chemistry to the Annuaire de Chimie of MM. Millon and Reiset. Paris, 1846.

† Proceedings of the Zoological Society, No. clii, Oct. 14, 1845.

‡ Dublin Medical Press, Dec. 11, 1844, and Edinb. Med. and Surg. Journ., Oct. 1845.

§ Gulstonian Lectures. Medical Gazette, March 14, e. s. 1845.

|| Schultze has made a similar observation in blood drawn after taking large draughts of water.

¶ Philosophical Mag., Dec. 1845, Suppl. p. 563, from the Annalen der Physik u. Chemie, lxvi, p. 177.

periments consisted chiefly in repeatedly agitating fresh drawn blood with atmospheric air, and then (with necessary cautions) washing out the absorbed oxygen and nitrogen with carbonic acid. The results of numerous experiments were pretty uniform. The quantity of oxygen obtained from the blood was from 10 to 12·5 per cent. of its volume, that of nitrogen from 1·7 to 3·3 per cent. Reversing the mode of experiment, it was found that blood could absorb 1½ times its volume of carbonic acid, and that, after all its oxygen and nitrogen had been washed out by carbonic acid, it could absorb, at a maximum, 16 per cent. of its volume of oxygen, and 6·5 of nitrogen. Similar experiments were made on old horses' arterial blood, and they proved that such blood naturally contains in simple solution from 10 to 10·5 per cent. of oxygen, and from 2 to 3·3 per cent. of nitrogen. And some further experiments lead the author to believe, that of this 10 per cent. of oxygen in arterial blood, about 5 per cent. are consumed in the systemic capillaries, and 5 per cent. remain in the venous blood, to be completed to the general average of 10 per cent. by the absorption of fresh oxygen in the pulmonary capillaries.

Life: capacity of organizing. Whatever doubt might still remain in the minds of some, whether Mr. Hunter maintained the truth in his doctrine that the blood could be organized, that is, that the whole substance of a portion of blood, being at rest either within or without a vessel, may develope itself into tissue and become vascular, and grow and nourish itself, must be satisfied by the observations of Dr. Zwicky[*] on the metamorphoses of the thrombus, or clot of blood which forms in a vessel above a part at which it is tied. For observations which, like these, stand on the boundary between physiology and pathology, no more space can be given than to state briefly the result; which is, that, to all microscopic appearance, the organization of the fibrine in an inflammatory condition and of that in a clot of blood is in all essential respects the same process, the presence of the blood corpuscles in the latter having no further influence on the process than that of somewhat retarding it. The whole process of the metamorphosis of the fibrine of the blood into fibro-cellular tissue, and of the formation of vessels in it is satisfactorily traced; and thus the only additional evidence which was needed is supplied for the establishment of another of the long-doubted Hunterian doctrines.

Modifications in disease. An account has already been given of the researches of Dr. Polli on the changes of blood in inflammation. The continued investigations of MM. Andral and Gavarret[†] have in numerous striking instances confirmed their account of the constant increase of fibrine in the blood in direct proportion to the increasing acuteness of the disease in all cases of inflammation, and of its regular and proportionate decrease in typhoid fever and purpura.

And these cases are confirmed by the laborious investigations of MM. Becquerel and Rodier,[‡] who have prefaced their pathological results by certain facts of more present interest in physiology. They give a standard table of the comparative constitution of the healthy blood of the adult male and female, showing the constant differences between them. As to the differences of constitution of the blood at different ages, they find none that is well-marked in men, but in women it is constant that the proportion of corpuscles is less before menstruation is fairly established than it is afterwards, and that when menstruation has ceased it again diminishes. In both sexes the cholestearine increases with increasing years after the age of between forty and fifty. The corpuscles are more abundant in the robust and well-fed. During pregnancy there is a great diminution in the proportion of corpuscles, a less considerable one in that of albumen, a slight increase of fibrine and of the

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* Die Metamorphose des Thrombus; von Dr. H. Zwicky. Zurich, 1845. 4to.
† Comptes Rendus, Séance du 18 Nov. 1844. ‡ Ibid. and Gazette Méd., 23 Nov. e. s.

phosphorized fatty matter, and an increase in the proportion of water. The other results obtained by these authors relate more exclusively to pathological states of the blood, but they are in that regard of very high interest.[*]

GENERAL ANATOMY AND PHYSIOLOGY OF THE TISSUES.

Fibro-cellular tissue and elastic tissue. Distinct filaments are described by Stadelmann[†] as demonstrable in the transverse sections of fibro-cellular tissue, cut and moistened after being dried. Their cut ends are like exactly circumscribed, pellucid circles, shadowed by sharp lines. Their diameters are all equal, and, as nearly as they could be measured, $\frac{1}{19000}$ of an inch. After similar preparation of portions of the elastic tissue, he finds the cut ends of its fibres round, ovate, triangular, or polygonal, circumscribed by pellucid lines, and separated by intercellular substance. They measure in the human ligamenta subflava from $\frac{1}{9174}$ to $\frac{1}{7037}$ of an inch : in the ligamentum nuchæ of the horse they are nearly twice as large.

Membranes. Much attention has been given to the arrangement of nerves in the serous membranes. The republished observations of Purkinje,[‡] on the nerves of the pia mater and arachnoid are noticed elsewhere. They are confirmed and added to by those of Mr. Rainey,[§] on the nerves in the arachnoid ; but these have been published since the time to which the Report has reference. M. Bourgery[||] also has given a long account of what he believes to be nerves of the peritoneum, dissected by the help of weak nitric acid, and briefer notices of those of other serous membranes ; but, in regard to the nerves of the peritoneum, since the cords which he dissected were not submitted to minute microscopic examination, and the microscope can discern only obscure traces of any nerves at all in that serous membrane, his description cannot yet be received as sure. So also, it must remain an open question, what amount of nerves the pleura receives, and how they are arranged[¶]

Cuticles, pigment, &c. E. H. Weber[**] has noticed that in all cases, but especially in the nasal ciliary epithelium of warm-blooded animals, the ciliary movement is accelerated by warmth and reduced to half its usual rate by cold. In this as well as in its rythmic action the ciliary movements are like those of the heart ; and there is no striking difference between them in regard of their period of continuance after apparent death, for he has seen the frog's auricle contracting for sixty hours, and after the blood in which it was placed had become quite putrid.

Dr. Moleschott[††] has examined the discoloration of the pigment of the

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[*] Papers on the development of the blood corpuscles have been read to the Royal Society by Mr. Newport and Mr. Wharton Jones, but I cannot gather an intelligible account of their results from the abstract given in the Proceedings of the Society, Nos. 60 and 61.

There is an agreeably written sketch of the present state of the pathology of the blood, by Wunderlich, with the title ' Pathologische Physiologie des Blutes, Stuttgart, 1845,' but there is nothing in it, I think, which is both new and interesting in physiology. Here also, as well as for the anatomy of the tissues, I may refer to Prof. Harting's ' Recherches micrométriques,' 4to, Utrecht, 1845, containing exact measurements of the blood corpuscles and other parts. The physiological part of the work is preceded by a careful discussion of the comparative merits of different methods of micrometry, among which, after minutely testing all, the author prefers the common plan by double sight, because it is the most convenient, always applicable, and, for very minute objects, liable to least error.

[†] Sectiones transversæ partium elementarium corporis humani ; Turici, 8vo, 1844, pp. 10 and 12.

[‡] Müller's Archiv, Hefte iii, iv, 1845.

[§] Report from the Med. Chir. Society in the Lancet, &c., February 27, 1846.

[||] Comptes Rendus, 8 Sept. and Gazette Médicale, 20 Sept. 1845.

[¶] See hereon Pappenheim, in the Comptes Rendus, Oct. 1845, and Purkinje l. c. p. 293.

[**] Archives d'Anat. génér. et de Physiologie, Janvier 1846, from a paper read at the Scientific Congress at Naples in 1845.

[††] Tijdschrift voor Natuil. Geschiedenis en Physiologie, 1845, St. 2, D. 12.

skin of frogs when they breathe in pure oxygen, held over water, so that the carbonic acid they produce may be absorbed. In a few hours the blackish-green elongated marks, extending backwards and downwards from the eyes, become lighter and greener. Then for several days the change goes on more slowly, but at the end of twelve days it is very distinct in all the spots; the dark semicircular marks on the thighs can then hardly be seen

The development of epidermis has been described by Mr. Erasmus Wilson[*] as consisting essentially in—1st, the production of "primitive granules" in the blastema; 2d, the collection of four, five, or six of these into "aggregated granules," which become the nucleoli of the complete cells; 3d, in the arrangement of a single tier of aggregated granules around each of these first aggregated granules, so as to form an oval or circular mass, a "nucleated granule," the nucleus of the complete cell; and 4th, the production of another tier of aggregated granules around the nucleated granule, forming a transparent border around it, around which border there is probably a cell-membrane, forming the proper epidermis cell or "nucleolo-nucleated cell." The growth of the cell he believes to be due to successive repetitions of the same process in the development and growth of aggregated granules within it, the full-grown cell containing secondary and tertiary cells and bodies in all the four stages of development above mentioned.

Cartilage. M. Valenciennes[+] has made an extensive examination of the structure of the cartilages in mollusca and cartilaginous fish, but the only facts which it appears important to state here are—1st, that the cartilage cells are generally arranged in such regular plans that it would be possible to determine by microscopic examination the order, or even the genus, of an animal, from the character of its cartilages; 2d, that none of the cartilage cells have, in any species, canaliculi communicating with them; and 3d, that gelatine, not chondrine, is abundant in the cartilages of cephalopods.

Bones: chemical analysis. A number of analyses of bones of various animals have been made by Dr. Stark.[‡] He shows that, besides their marrow [i. e. I suppose, all the fat that can be easily scooped out of the cancellous tissue], the bones of mammalia contain from 13·5 to 29·2 per cent. of fatty matter. The solid part of the shaft of the canon bone of a sheep contained 4·3 per cent. The bones of almost all birds under one year old contain an oleo-albuminous (?) matter, which, as the bird grows older, is absorbed. No less than 232 analyses of various bones from all the vertebrate classes are given, to show the proportions of animal and earthy matters; and the result is, that in all bones the proportion is nearly the same, the average proportion for all being 66·09 of earthy matter to 33·91 of cartilage. No confirmation is afforded of the notion that the proportion of earthy matter is the larger the higher the animal is in the scale of creation, for the largest proportion (68·74) was in the true bones of cartilaginous fishes—the smallest (61·9 to 62·3) in the bones of the bear and marmozette monkey The proportion of earthy matter appeared a little greater in the wild than in the domesticated mammalia. There was no evidence found of its increasing with age in either men, cows, or sheep. Neither did the hardness, or inflexibility, or want of transparency of bones appear to be dependent on the earthy matter being present in a very large proportion, but on the mode in which the textures of the bone were held together.

Structure. Mr. Goodsir[§] states that in the cavity of each bone-corpuscle, but not extending into the canals, there is " a little mass of nucleated cells of great transparency." This he regards as the *germinal centre* of the texture or

* Proceedings of the Royal Society, No. 61, June 19, 1845; and Philosophical Mag., Feb. 1846.
+ Comptes Rendus, 25 Nov. 1844.   ‡ Edinb. Med. and Surg. Journ., April, 1845.
§ Anatomical and Pathological Observations. Edinburgh, 1845. 8vo, No. x, p. 64.

of the cells comprehended within the canals of the corpuscle which it occupies, through which canals, also, he supposes that the nutritive material which the mass of cells attracts into the corpuscle is conveyed for the nutrition of the hard parts between them. He also describes the tissue which lies between the blood-vessels and the walls of the Haversian canals as a layer of cellular substance, at least in the fœtus, for in the adult it is replaced by fat.* In another paper† he describes, (as a source of fallacy in those experiments in which it appeared that, when a piece of bone was removed and its periosteum was left, the periosteum reproduced the lost bone,) how that it is hardly possible to separate periosteum from bone without detaching minute portions from the surface of the bone; and that these, adhering to the periosteum, may serve as nuclei for the production of the new bone, which thus seems to be produced from the periosteum itself.

Development. The early stages in the development of bone are described by Köstlin,‡ from the examination of a thin layer of new bone (osteophyte), which lined nearly the whole skull of a woman who died three weeks after delivery. His account has, perhaps, less of special than of general interest, for it may not be true of the ordinary development of bones, but it confirms the account given by Karsten§ and some others, of the general plan of cell-development. He finds that, in a homogenous membrane formed in the earliest stage of the exudation, there are first formed scattered elementary granules. These gradually increase in number; some enlarge, some coalesce, and the larger granules thus formed separate into a moderately thick wall, a dark contents, and an eccentric nucleus. Thus they become primary cells; and these also enlarge by growth and coalescence. At first their form is nearly spherical, but they gradually become less regular, and, their contents disappearing, they become also less turgid and clearer, and their nuclei more numerous. As their contents disappear so their walls coalesce with the intercellular substance, and their nuclei become imbedded in it. The number of these nuclei increases still more and they become darker by the in-taking of earthy matter; and, moreover, there is formed from the intercellular substance around each cell a group of dark corpuscles like the nuclei, which acquire a regular arrangement in regard both to them and to one another. Their arrangement is such, that if one imagines them connected with one another and with the nuclei by dark lines, and the cell spaces darkened by the reception of earthy matter, one will have the common bone-corpuscles with the dark network of the so-called calcigerous canals.

Periosteum. Purkinje‖ has found (as Pappenheim¶ also did) a copious network of nerve filaments in periosteum. He examined particularly that of the front of the tibia, and that of the vertebral canal. In the latter, which he describes as formed by an outer layer of the dura mater, divided into two layers at the foramen magnum, he found abundant bundles of fine-fibred nerves, which appeared to communicate through the intervertebral foramina with the sympathetic.

Muscular tissue: its structure, action, and growth. Stadelmann,** in transverse sections, could never detect any appearance of an empty space or canal in the axis of the striated muscular fibre, such as Valentin and others have described.

E. Weber†† has examined the mode of contraction of the muscular fibres

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* I cannot make out what is described as the mode of origin and development of the cells of this layer of substance.

† No. xi.

‡ Müller's Archiv, 1845, Heft. i.

§ See last Report, p. 37.

‖ Müller's Archiv, Heft. iv, p. 289.

¶ Last Report, p. 10.

** Archives d'Anat. Gén. et de Physiologie, Janvier 1846, from the Report of the Scientific Meeting at Naples in 1845.

†† L. c., p. 15. The rest of his account of this tissue confirms Mr. Bowman's.

under the favorable condition of continued contraction, into which the frog's muscles are thrown when excited by the electric current from a rotating magnet. He finds that the contraction is always by simple shortening, and never by zig-zag flexures of the fibres; and that these are formed, as Mr. Bowman stated, only when the fibres relax, and by their elasticity tend to elongate. He shows also that, in contraction, the fibres do not become harder, and that it is only their increased tension when contracted which makes them feel harder, as it does also the tendons and other tissues at the same time.

Dr. Helmholtz[*] appears to have obtained a more direct proof than hitherto existed, that chemical decomposition accompanies the action of a muscle. With all due precaution he electrified the hind legs (say the right hind legs) of frogs till their muscular irritability was exhausted, and then compared the results of the analyses of the muscles of these and of the other hind legs of the same frogs, which, except in that they had not been electrified nor in any way excited to muscular action, had been kept in the same external conditions. The result was, that in every case the quantity of alcoholic extractive matter was found to be increased in the electrified muscles, and the quantity of water-extractive matter decreased in them. The proportionate quantities of the former in the electrified and in the non-electrified were (on an average of six experiments) as 1·33:1, and those of the latter as 0·78:1. Similar results were obtained by like experiments with an eel-pout and with a pigeon. Of the other constituents of the muscles;—the changes, if any, in the fibrine could not be determined; the differences in the quantity of albumen were inconsiderable; the fat appeared unchanged. Counter-experiments were made, which showed that electricity did not produce similar changes in muscles whose irritability had been previously exhausted, and that the changes were not due to ordinary spontaneous decomposition.

Together with many observations on the minute structure of the muscles of hymenoptera, Prof. Harting[†] has given an account of the comparative dimensions of the muscular fibres of the new-born child and adult, showing that the average diameter of the primitive fibres in the child is to that in the adult as 1:3·64, and the respective average intervals between the transverse striæ as 1:1·18. In the child the distance between the striæ is to the width of the fibre as 1:4·415; in the adult as 1:8·42. It is hence deducible that the ordinary growth of a muscle is due to the increase in size, not in number, of its primitive fibres; but whether this increase of size is due to enlargement, or to increased number, of the primitive filaments, could not be determined. It is evident also, that of the growth of a muscle in its length, part is effected by the increase in the length or depth of the particles (?) on which its transverse striation depends; but this is not enough to account for the whole growth of a muscle between childhood and manhood; so that part of the growth in length must be ascribed to the increased number of these particles (?).

He has also measured the muscles and their elementary parts in the healthy and the paralytic arm of an adult; from which it appears that the diminution of size accompanying the paralysis of the muscles was due to a diminution in the size, not in the number, of the primitive fibres. But with the diminution in the size of the muscles there was no corresponding diminution of the nerves: both their trunks and their ultimate fibres were of equal size in both arms.[‡]

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* Müller's Archiv, 1845, Hefte i, ii.   † Tijdschr. voor Naturl. Geschied. en Physiol. d. xii.

‡ See further on this subject in the section upon Nutrition. And on the several tissues refer to. 1. C. Bruch, Untersuchungen zur Kenntniss des körnigen Pigments; Zurich, 1844, 4to, containing a clear account of all that is known of pigments, whether healthy or morbid, with some original observations. 2. J. E. F. Knorz, De pili structura et genesi; Marburg, 1844, 8vo, of which a similar account may be reported. 3. Dr. Gregory, On the presence of Phosphate of Magnesia in Bone, and on a new method of obtaining Phosphoric Acid from Bones; in the Medical Gazette, April 11, 1845. 4. C. G. L. Bruch, Nonnulla de Rigore Mortis; Magunt, 1845, 4to, confirming by new evidence the

CIRCULATION.

Action of the heart. Dr. Mitchell,* in a case of ectopia cordis, watched the movements of the heart for an hour and fifty minutes. The pulsations were twenty-five in a minute before the separation of the umbilical cord ; after it they fell to twenty, and then to seventeen. After the auricles were distended with blood they emptied themselves by a gentle flowing motion, and immediately after this the ventricles contracted. The effect of the ventricular contraction was to shorten the heart from base to apex, and to cause a considerable bulge or projection in the centre, giving rise to an evident elevation of the fingers when laid on it. The apex of the heart was *not* elevated. After the ventricular contraction the heart appeared quite flaccid and relaxed, although it was evident that the ventricles were not emptied.

Volkmann† has discussed the relation of the movements of the heart to the nervous system ; and, to prove that they do not depend on the brain and spinal cord, he adduces the fact that they continue after the heart is cut out, while all the rythmical movements which do depend on the brain and cord, such as those of respiration and the lymph-hearts, cease as soon as their connexion with parts of those nervous centres is destroyed. He supposes, therefore, that the movements of the heart depend on the *immanent* power of the sympathetic nerve-fibres and ganglia in its substance. His experiments show, that if the auricle and ventricle, while pulsating rythmically and in harmony in a fresh frog's heart, be suddenly separated from each other, though they may both continue to pulsate they will not pulsate in harmony. And when the ventricle is divided by incisions carried through nearly its whole length, some of its portions will continue to pulsate spontaneously and rythmically, while others, just as large, will only move when irritated. He thinks that this shows that, in the former, central organs remained from which impulses for movement might proceed, while in the latter there were no such central organs or ganglia. He concludes, therefore, that the ganglia in the heart are so many central organs, or points from which motor impulses flow out, and that they are suited for action in concert by connecting nerve fibres, forming altogether a system so arranged as to produce, in regular series, the successive contractions of the muscles of the heart.

This theory coincides in many points with that of Kurschner, alluded to in the last report ; and he holds that the auricles are the parts to which the reflex influences of the ganglia are always first directed, and that the contraction of the ventricles is the consequence of the contraction of these. In evidence of this he says, that whatever part of a heart, when cut out but still irritable, is irritated, the consequent contraction always begins in the auricle. [But it is certainly not always so : I have many times tried the experiment in cut out turtles' hearts, and have always found that the contraction begins at the part irritated and thence extends over all the rest.] Valentin,‡ also, has made experiments on the same question, but he doubts whether the rythmical contractions of the heart are dependent wholly on its nervous system, and not in part on the mechanical arrangement of its fibres ; since, he says, the continuance of rythmical movements is observed only in those pieces of the heart

established view that the rigor is due to the contraction of the muscles. 5. Harting, Histologische Aaanteekeningen ; in the Tijdschrift already referred to. Besides the papers on the muscles, lens, and nerves, of which an account is here given, the essay contains remarks on the milk-corpuscles, the action of sublimate on the blood-corpuscles, and other questions of the anatomy of tissues. The continuations of the admirable works of Dr. Sharpey, in the new edition of Quain's Anatomy, of Dr. Todd and Mr. Bowman, in their Physiological Anatomy, and of Mulder, in his Physiol. Scheikunde, are also important contributions to the recent history of general anatomy.

* Dublin Journal of Med. Sciences, Nov. 1844.   † Müller's Archiv, 1844, Heft iv, p. 424.
‡ Handb. der Physiologie, Bd. ii, p. 767.

which remain connected with portions of the tissue intermediate between the auricle and ventricle. Kölliker,[*] also, while he agrees with Volkmann's explanation of the rythmical action of the heart, states this as a fact which he, like Valentin, has observed in frogs' hearts. [But in the hearts of turtles, the size of which makes the fact evident enough, it is very different; I have often seen the apex of the heart continuing its rythmical contractions long after being cut off from the rest of the ventricle. Both auricles also continue similarly contracting when cut off above the auriculo-ventricular rings; but their contractions are not synchronous. Indeed, I do not remember to have ever seen any difference, in respect of the continuance of their rythmical action, whether the pieces cut from the heart were or were not connected with the tissue uniting the auricles and ventricles.[†] I believe, therefore, that Volkmann's theory may be held as true; but that there is no evidence at present for assigning a peculiar locality for the chief centres for harmonizing the rythmic actions of the heart.]

Arteries. An account of the structure of the blood-vessels, confirming in all respects that of Henle, and supporting the microscopic by chemical evidence, so far at least as the action of acetic acid and potash on the several coats is concerned, is given by Mulder,[‡] from examinations by himself and Donders.

The nerves of the arteries are among those which Purkinje[§] has submitted to renewed investigation. He finds, by the help of acetic acid, all the plexus of arteries in the rete mirabile of the ox surrounded by a close web of nerves.

In an excellent essay on the anatomy of the parts concerned in laryngotomy and tracheotomy, Dr. Gruber[||] has treated especially of the middle thyroid (A. thyroidea ima seu Neubaueri) and the crico-thyroid arteries. The former occurs in about ten per cent. of the bodies examined, arising in general from the innominata, more rarely from the arch of the aorta or the common carotid, more rarely still from the inferior thyroid or thyroid axis, and most rarely from the internal mammary. It probably never arises from the left carotid; when it appears to do so the artery thus arising should be called a second inferior thyroid. Its diameter varies from half a line to two lines and a half; in two cases, with healthy thyroid glands, its trunk measured five lines. It is more frequently on the right than on the left side; and once only in ten cases was double. It may proceed vertically up the front of the trachea to the isthmus or either lobe of the thyroid gland, or it may pass obliquely across to the trachea, even going from its right side to the left lobe of the gland.

In regard to the crico-thyroid artery, Dr. Gruber notices especially that arrangement in which it is very large on one side, having a diameter of from three-quarters of a line to two lines. This is most often observed when there is a middle lobe to the thyroid gland, but the large artery is not always on the same side as the middle lobe. Such an artery occurs about once in every four persons, and is more frequent on the right than on the left side. Its place may be taken by the thyroid branch of the right superior thyroid artery. The large artery in most cases bends down at a right angle in front of the crico-thyroid membrane, to reach the isthmus of the thyroid gland, and gives off at its bend a small branch which crosses the membrane. More rarely the

* Die Selbständigkeit und Abhängigkeit des sympathischen Nervensystems. Zurich, 1844. p. 36.

† It is, however, I think, necessary for the propagation of contraction from one part of the heart to another, that they should be connected together by muscular tissue; probably because there are nerves in it. If two portions of a heart be held together by a very narrow isthmus of muscle, the contraction excited by irritating one will extend to the other; but this will not happen if the connecting isthmus be tendinous tissue, even though it be a piece of the auriculo-ventricular ring.

‡ Physiologische Scheikunde, St. vii, p. 664.   § Müller's Archiv, Hefte iii, iv.

|| Oesterreich. Medic. Jahrbücher, Mai u. Juni, 1845.

trunk of the artery crosses the crico-thyroid membrane and reaches the opposite side. It gives branches to the larynx through the crico-thyroid membrane, to the middle lobe of the thyroid gland, to the lobe of its own side, and when it crosses over, to that of the other side also, and very often to the isthmus of the gland.*

Capillaries. Observations on the development of the capillaries in tadpoles and the tails of young tritons by Platner† indicate, as some others have done, that new capillaries are formed by outgrowths from old ones. First, capillaries are seen which have abrupt blunt closed ends; some of these have no trace of prolongation, but many exhibit a very thin, long *outrunner* which is gradually lost sight of; and in some cases it may be seen how two such thin canals as these unite and form one arch, which gradually increasing becomes a new capillary loop. At first this is filled by finely granular matter, and is too small to admit blood-corpuscles. It soon acquires distinct walls, but the nuclei found on fully developed capillaries are subsequent formations.

Veins. Henle described generally the differences of structure of veins in different parts of the body according to the degree in which the longitudinally fibrous coat is developed; that in some it is hardly discernible, in others strongly marked; but he did not indicate the veins thus differently conditioned. The result of many dissections by Dr. Norman Chevers‡ is that, as a rule subject to but few exceptions, the deep-seated veins of the trunk have their proper or middle coat (wherein I suppose he includes all between the striated coat and the external cellular coat) composed almost entirely of circular fibres; while in the external and superficial veins there is in the same situation a strong internal layer of longitudinal fibres, and a thinner layer of circular fibres next external to it.

Venous pulse. Two cases of pulsations in the veins of the back of the hand, coincident with the pulse of the arteries, are recorded by M. Martin-Solon.§ Both occurred in patients who had been largely and repeatedly bled for pleuro-pneumonia. M. Poiseuille, in a discussion on the essays, referred to cases recently recorded in a thesis by Condret, in which the persons presenting the venous pulse were strong young men with full arterial pulses ||

RESPIRATION.

Structure of the lungs. Some interesting points in the anatomy of the lungs are determined by the investigations of Mr. Rainey.¶ The air passages he divides

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* For the practical deductions from these anatomical facts I must refer to the original paper.
† Müller's Archiv, 1844, Heft v. ‡ Medical Gazette, Aug. 8, 1845.
§ Bull. de l'Académie de Médecine, Nov. 1844, pp. 102-116.
|| All the physics of the circulation are well discussed by Bergmann in his article, "Kreislauf des Blutes," in Wagner's Handworterb. der Physiologie. There is an exposition of the theory of the wave-movement of the blood in the arteries, and of the mechanism of the pulse, by Dr. H. Frey, in Müller's Archiv, 1845, H. ii, iii. His essay is in full support of the theory as commonly received: against it there are, an anonymous very clever essay "On the Cause of the Pulse," in the Medical Gazette, July 11, 1845, and one with the same title by Dr. Thomas Williams, in the same, July 25, 1845. The opinions in these two essays differ in degree rather than in kind. It seems to me that the existence of what may be justly termed a wave of blood raised by each contraction of the ventricle, is quite certain: the main question is, how far does the first wave extend? None of the essays answer this question; and it is not possible to give an answer which shall be always true, for both the breadth and height of the wave must, in different cases, depend on very many variable conditions, of each of which we can as yet obtain only an uncertain estimate. Other works of more or less interest in the anatomy and physiology of the circulatory system are,—Parchappe, Sur la Structure . . . du Cœur; Paris, 8vo, 1844. Pliny Earle, Observations [with extensive statistics] on the pulse of the Insane; in the American Journ. of Med. Science, January 1845. Norman Chevers, On the effects of obliteration of the Carotid Arteries; in the Medical Gazette, Oct. 31, 1845. Bouisson, Sur les lésions des artères fessière et ischiatique; in the Gazette Médicale, Mars 1845, containing measurements of the exact relative positions of these vessels. Prevost et Lebert, Sur le développement des organes de la circulation . . . du poulet; in the Annales des Sc. Nat., t. i, 1845.
¶ Medico-Chirurgical Transactions, vol. xxviii, p. 581, 1845.

into the bronchial tubes and the intercellular passages continued from them, taking for the line of demarcation between them the parts at which the mucous membrane and ciliary epithelium of the bronchi terminate. These terminate abruptly in bronchi of from $\frac{1}{50}$ to $\frac{1}{30}$ of an inch in diameter; the mucous membrane retaining to this boundary its longitudinally and circularly fibrous character and its pale colour. Beyond the boundary, the tubular form of the air passages continued from the bronchi is for some distance retained, but it is more and more lost as the passages branch and approach the surface of a lobule, and as the number of air-cells which open into them continually increases. Thus, at last, each minute division of the air passages becomes quite irregular in its form, air-cells opening into every part of it, and almost constituting its walls, till itself ends, without dilatation, in an air-cell. Beyond the boundary at which the bronchial mucous membrane abruptly terminates the walls of the air-passages are formed only by a membrane similar to that which walls-in the air-cells; and they have no epithelium. Those air-cells are smallest and most vascular which are situated nearest to the centre of the lung; their size increases and their vascularity diminishes at the parts nearer the circumference—in adaptation, probably, to the larger and more ready supply of fresh air to the former parts. Those cells which open directly into the bronchial tubes and intercellular passages open into them by large circular apertures; they are themselves similarly opened into by other cells, which again are similarly opened into by others; forming thus, for each opening into a tube or passage, a series of communicating cells; each series reaching usually from the passage to the surface of the lobule. The cells which are placed in the angles of the branching of an intercellular passage probably open into both the branches, as well as into one another. The walls of the air-cells, on which the capillaries are placed, are formed by thin and transparent but fibrous membrane, which in the formation of the successive communicating cells is folded, or as if constricted, so as to form a definite sharp-edged circular opening of communication between each two, and between the first of the series and the passage into which it opens. In the reptiles the corresponding folds bordering the sacculi of their lungs inclose each a double or folded layer of capillary plexus; in the mammal's lung each such fold incloses a single layer of capillaries, so that both sides of all these capillaries are exposed to the air in the adjacent cells. And this plan of arrangement and structure of the air-cells exists in the mature mammalian foetus just as it does in after-life.*

Nerves of the lungs. In his admirable essay on the physiology of the nerves, Volkman,† to prove the influence of the pneumogastric nerves on the bronchial tubes, relates an experiment analogous to those performed by Dr. C. J. B. Williams. He tied a glass tube drawn fine at one end into the trachea of a beheaded animal, and when the small end was turned to the flame of a candle he galvanized the pneumogastric trunk; every time he did so the flame was blown, and once it was blown out. The experiment succeeded even when the chest was opened; but the lungs having then collapsed, the efflations were slighter. The movements following the irritations were pulse-like.

Air-changes in respiration. Dr. Marchand,‡ from experiments on frogs, confirms the observation of Valentin and Brunner,§ that there is always more oxygen absorbed in respiration than is employed in the formation of the carbonic acid expired. The surplus combines with hydrogen, and forms water. When the animals were deprived of food, less carbonic and more water were

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* There is a paper on the anatomy of the lungs by Dr. Eichholtz in Muller's Archiv, H. v, 1845, in which he tries to prove that the nuclei of certain cells, like hepatic cells, which he finds in the lungs, are transformed into blood-corpuscles. Moleschott, De vesiculis pulmonum Malpighianis; Halæ, 1845, 8vo, describes, but less perfectly, nearly the same structures as Mr. Rainey.
† Wagner's Handworterb. der Physiologie. Art. Nervenphysiologie, p. 586.
‡ Medic. Central-Zeitung, Oct. 9, 1845.   § See last Report.

formed   He found that frogs would not live more than three hours in hydrogen, however pure ; they soon went to sleep, and gradually died.

Dr. Vierordt* has performed on himself a series of 578 experiments to determine, chiefly, the variations produced by different internal and external conditions in the results of the respiratory process. The full evidence for his deductions is given in numerous tables.† He shows, in a first section, the influence of variations in these following conditions : 1. *The time of day.* From 9 to 10 a.m. the pulse becomes less frequent ; from 10 to 12 it is stationary ; from 12 to 2 it increases fast and much ; from 2 to 7 p.m. it regularly falls to the frequency of 9 a.m. In the same periods there are nearly corresponding changes in the number of respirations ; but at 7 p.m. they are less numerous than at 9 a.m. There is a slight increase in the quantities of air and of carbonic acid expired in a minute between 9 and 10 a.m. ; a slight decrease between 10 and 11 : a greater decrease between 11 and 12 ; a very great increase between 12 and 2 p.m. ; and a nearly regular and great decrease from 2 to 7 p.m., at which latter time they are much less than at 9 a.m. The increase from 12 to 2 is probably due to the influence of feeding and digestion, for the chief meal was between 12 and 1, and if it were not taken the respirations diminished before 2 p.m. The other changes also are probably due to variations in other internal processes rather than to those of external circumstances. 2. *The effects of dinner* are to produce an increase, *per minute*, in the pulse of 16·3 beats ; in the respirations of 1·72 times ; in the air expired of 269 cubic inches ; in the carbonic acid expired of 19·37 inches. The evening meal produces similar but slighter effects in all but the frequency of the pulse, which is unaffected by it. 3. *Spirituous drinks*, as Dr. Prout showed, diminish the exhalation of CO_2 by $\frac{1}{2}$ per cent., or $\frac{1}{8}$ the whole quantity previously exhaled in a given time ; and they do this especially when taken into an empty stomach   4. *Bodily exercise*, in moderation, makes the exhalation of carbonic acid about $\frac{1}{3}$ more than it is during rest ; and for about an hour after exercise there is an increase of about 118 cubic inches in the air expired per minute ; and an increase of 14 per cent. in the proportion of CO_2 contained therein. 5. *Sleep.* Vierordt has not examined the products of respiration during sleep, but he fully confirms Dr. Prout's observation that there is a great, though quickly transitory, increase in the exhalation of CO_2 directly after, or even in the act of, waking. 6. *A change of external temperature* equal to 10° F. produces the following changes in the rates per minute : in the number of respirations, ·28 ; in the quantity of air expired, 33·4 cubic inches ; in the carbonic acid expired, 2·114 cubic inches, or ·0183 per cent. These changes are by increase when the external temperature diminishes, and by diminution when it increases. The temperature in which the observations were made ranged between 38·7 F. and 75·7 F. Within this range the pulse is unaffected by the changes. 7. *A rise in the barometer* equal to half an inch increases the rate per minute, of the pulse, 1·3 ; of the expirations, ·74 ; of the quantity of air expired, 230 cubic inches ; and, as Dr. Prout showed, diminishes the relative proportion of CO_2 expired by ·3 per cent. The barometric pressures in which the observations were made ranged between 29·3 and 30·2 inches. The influence of changes of atmospheric pressure was greater when the temperature at the time was high.

In a second section Dr. Vierordt discusses the influence of *variations in the respiratory movements* on the products of respiration : 1st, *In various frequencies of respiration* the proportionate quantities of CO_2 in the expired air are, with six respirations in the minute, 5·528 per cent ; with 12, 4·262 ; with

* Physiologie des Athmens ; Karlsruhe, 1845, 8vo.

† The mode of investigation is also detailed ; but, as it was the same in all the experiments, it is unimportant to notice it here. Moreover, I have noticed only the facts obtained by his investigations ; but the work contains, besides these, many useful deductions from the labours of others.

24, 3·355; with 48, 2·931; with 96 respirations in the minute, 2·662 per cent.* But the absolute quantities of CO_2 exhaled in a minute in the same circumstances are (since by rapid breathing the whole quantity of air that is breathed is proportionally increased) as follows: with 6 respirations per minute, 171 cubic inches; with 12, 246 cubic inches; with 24, 396 cubic inches; with 48, 696 cubic inches; with 96, 1296 cubic inches. 2d. *By increasng the volume or depth of the respiration*, the per centage proportion of CO_2 in the expired air is diminished; in the deepest respiration it is 1·97 per cent. less than in ordinary breathing. But for this proportionate diminution also there is a full compensation in the greater total volume of air which is thus breathed; for equal volumes of expired air, whether breathed slowly or quickly, deeply or not, contain equal quantities of CO_2. 3d. It appears, moreover, that if the air in one ordinary expiration contains on an average 4·48 per cent. of carbonic acid, the air expired in the first half of the whole expiration contains ·76 per cent. less than this average, and that expired in the last half contains ·96 per cent. more than the average, proving that the air in the parts of the lungs nearest the great bronchial tubes contains less CO_2 than that in the deeper and more distant parts does.† 4th. *In holding the breath*, the proportion of CO_2 in the air within the lungs increases greatly, but in a diminishing ratio; in one minute's holding it becomes 2·42 per cent., and in 100 seconds 3·08 per cent. more than it is in an ordinary expiration. In this condition also the composition of all the air within the lungs very soon becomes uniform.

Finally, Vierordt shows how wide the range of occasional variation is within which, even in health and perfect bodily rest, the several parts of the respiratory functions are discharged. In these conditions the pulse ranged, in occasional instances, between 54 and 101 per minute; the respirations between 9 and 15; the expired air between 1637 and 3676 cubic inches; the carbonic acid therein contained, between 3·358 and 6·22 per cent.; the volume of each expiration between 144·6 and 275 cubic inches

The changes in the quantity of carbonic acid exhaled in much higher and lower temperatures than Vierordt observed them in have been investigated by M. Letellier.‡ The experiments were performed on small birds, mice, and guinea pigs, who were made to respire for periods varying from half an hour to six hours. The results are stated in tables which show generally that the quantity of carbonic acid exhaled at a temperature between 82° and 104° was about as much below the average at ordinary temperatures as the quantity exhaled at temperatures about zero were above the same average; and the greatest quantity exhaled at the lower temperatures was about twice as much as the smallest exhaled at the higher temperatures. None of the animals experimented on could live without danger in a temperature equal to that which is natural to their own bodies; and all speedily died when the temperature was increased to 5° higher. At temperatures from 80° to 92° they lived and breathed quite tranquilly.

Hannover,§ also, has instituted experiments to determine the quantities of carbonic acid exhaled in certain diseases, and finds, 1, that chlorotic females exhale an absolutely larger quantity of it than healthy ones do; 2, that the quantity is much diminished in all cases of phthisis; and, 3, that it is little or not at all changed in bronchitis.

Asphyxia. Many interesting matters connected with the physiology of respiration are well discussed and illustrated by Mr. Erichsen,‖ in his essay on

* The author hence deduces a general rule for calculating the proportions, in which, however, he is probably premature.

† See, on the anatomical adaptation of the lungs to this condition, Mr. Rainey's Observations, at p. 14.   ‡ Annales de Chimie et de Physique, Avril 1845, p. 478.

§ De Quantitate . . . acidi carbonici ab homine sano et ægroto exhalati; Havniæ, 1845, 8vo.

‖ An Experimental Inquiry into the Pathology and Treatment of Asphyxia; Edinburgh, 1845, 8vo.

Asphyxia. 1. To show that, although the cessation of the respiratory movements is not the sole cause of the cessation of the circulation in asphyxia, yet their continuance enables it to be continued longer than it will after they have ceased, artificial respiratory movements with a small quantity of air (a quantity too small to retard materially the occurrence of asphyxia,) were maintained in a dog till all the chemical respiratory changes had ceased, and the heart was motionless. On examination after death, the difference between the quantities of blood in the two sides of the heart was not nearly so great as in ordinary cases of asphyxia : the left cavities contained nearly as much blood as the right ; proving that the respiratory movements, unassisted by the chemical changes, had for a time facilitated the passage of blood through the lungs. 2. To show that the arrest of the blood in the small vessels in asphyxia is not the consequence of the action of venous blood in the nervous centres, three dogs were so arranged that while one of them was being asphyxiated by ligature of the trachea, arterial blood might be propelled through its carotids from the carotids of the other two. Care was also taken to prevent the passage of venous blood through the vertebral arteries of the asphyxiated dog, and to prevent congestion of its nervous centres by opening one of its jugular veins. The result was that the dog was asphyxiated in the ordinary time, and that there was the usual amount of congestion of its vessels, although arterial blood had, throughout the experiment, circulated through its nervous centres.

3. Two experiments are related in evidence that, if the action of the heart be maintained, black blood may be propelled by it through a lung long after the chemical respiratory changes have ceased. Dogs were pithed, and while artificial respiration was being maintained the right bronchus was tied. As long as the heart's action continued (and it continued much longer than in ordinary cases of asphyxia), there flowed nearly as much black blood through a right pulmonary vein as of red blood through a left one.

4. A description is given of the contraction of the small arteries, and distension of the veins of the mesentery during asphyxia, as observed with the microscope. And this contraction is maintained to be the principal or sole agent in the obstruction to the passage of the blood observed in asphyxia, the black blood being regarded as a stimulant to the contractile coats of the small systemic arteries and pulmonary veins. [But the description does not disagree with the more probable opinion that the small arteries of the mesentery contracted only because less blood was impelled into them.]

Mr. Erichsen's conclusion from these and some other previous experiments* is that the cessation of the circulation in asphyxia depends upon all three of those circumstances, to each of which, by various former writers, it has been exclusively ascribed : viz., 1, the arrest of the respiratory movements ; 2, and more importantly, the weakening of the heart's action in consequence of the lessened quantity and altered quality of the blood which passes into the left ventricle, and the coronary arteries ; 3, obstruction to the blood in its passage through the small vessels. [i. e. as he thinks, by the refusal of the minute pulmonary veins and systemic arteries to receive venous blood, but, as others believe, because the capillaries cannot transmit blood charged with carbonic acid.]

The average periods, in minutes and fractions thereof, at which the chief phenomena of asphyxia are observed in dogs are stated thus : voluntary movements cease in $1\frac{3}{4}$; involuntary in $2\frac{1}{2}$; the blood in the arteries becomes as black as that in the veins in $1\frac{3}{4}$, or, occasionally, in $1\frac{1}{4}$; ventricular contractions cease in $9\frac{1}{2}$ (at the earliest in $6\frac{1}{2}$, the latest, in adult animals, in 14) ; the left auricle ceases to act in 18 minutes, the right in $19\frac{1}{2}$, but once, in an adult animal, the former continued acting for 37, and the latter for 44 minutes ;

* Medical Gazette, 1842.

pulsations in the femoral artery continue for $7\frac{1}{2}$ minutes. In puppies four days old the ventricles contracted regularly for 117 minutes, and with irregular movements for three hours; and the auricles continued acting for three hours and twenty-five minutes.

ANIMAL HEAT.

Liebig[*] has shown the error of the opinion derived from Dulong and Despretz, that the quantity of heat generated by an animal which consumes by respiration a certain quantity of oxygen in a given time, is less than would be produced by the direct combustion of carbon and hydrogen in the same quantity of oxygen. He proves that this opinion is founded on incorrect premises; the combustion-heats of carbon and hydrogen having been reckoned too low by both Dulong and Despretz; and having established the authority of new and more accurate numbers to represent these combustion-heats, he shows that the amounts of heat developed by animals consuming certain proportions of oxygen, are nearly equal to those which are produced by the direct combustion of definite proportions of carbon and hydrogen in the same quantity of oxygen.

For the sake of their relation to the foregoing observations of Vierordt, I place here some of these by Gierse,[†] whose work should have been noticed in the Report for 1842-3. At different periods of the day, he found the temperature under his tongue as follows:—from 11 p.m. to 2 a.m. 98·26° F.; from 6 to 8 a.m, before breakfast, 98·55° F.; from 6 to 8 a.m on other days, after breakfast, 98·73°; between 9 and 11 a.m., 99°; just before dinner, 98·82°; after dinner, 99·5; between 3 and 6, p.m., 98·61°; between 6 and 10 p.m., 98·86°; from 11 p.m., to 1 a.m., while asleep, 98·15°. All the other observations by this author relate to the temperature of inflamed parts, except a few from which he believes that there is no increased heat in the vagina during menstruation or parturition. He found almost constantly that an inflamed part communicated its heat to the thermometer more rapidly than a healthy part of the same temperature did. He found also that, in animals, struggling and excitement commonly raised the temperature more than the inflammation of a part did.

Some of these results also, are confirmed by Dr. John Davy.[‡] He finds the temperature highest in the morning, on rising after sleep; high, but fluctuating, till the evening; and lowest about midnight, ranging from 98·7° to 97·9°. In active exercise, within the limits of exhaustion, the temperature of the body is increased in direct proportion to the exertion; in passive exercise in the cool air it is lowered; during quietude in an atmosphere from 42° to 32°, it may be reduced from 1° to 2°. Sustained mental exertion slightly raises the temperature; a light meal scarcely alters it; a heavy one lowers it.

Sundry observations are recorded by Dr. Dowler and other American surgeons[§] of considerable increase of temperature of the surface of the body after death from yellow fever and coup de soleil. Within a few minutes after death the temperature is said to rise to 102°, and then to increase steadily to 106° or 108° or even to 113°. Thus it may remain for from four to six hours, being usually higher at the thigh and abdomen than in the heart; then it gradually subsides to the temperature of the surrounding medium. The cases are said to have all occurred in the summer, in a temperature of at least 80°; but they are very imperfectly related. In the paper first referred to in the subjacent notes, another phenomenon is mentioned, which is certainly very rarely if ever observed in this country, namely, the maintenance of the power of forcible contraction in the voluntary muscles for six or seven hours after death. When all the muscles of the fore-arm are dissected bare (the arm

* Lancet, Feb. 22, 1845, and Annalen der Chemie und Pharmacie, Jan. 1845.
† Quænam sit ratio caloris organici, Dissert. inaug.; Halæ, 1842, 4to.
‡ Proceedings of the Royal Society, No. 61, June 19, 1845.
§ B. Dowler (New Orleans), in the Boston Medical Journal, Aug. 6, 1845; in the New York J. of Medicine, Sept. 1845; in the Medical Examiner, Sept. 1845.

being amputated at the shoulder) a blow with the hand will excite powerful contractions in the bared muscles; and twenty minutes or more after death a large hatchet weighing three pounds being tied in a subject's hand, it is said that the fore-arm was bent several times so as to raise the hatchet and strike the trunk as often as the flexor muscles were struck with the hand.

DIGESTION.

STRUCTURE OF THE DIGESTIVE ORGANS; *The Tongue.* Dr. Nuhn* has minutely described a pair of glands in the substance of the lower part of the apex of the tongue. Each gland lies about two lines from the median line, just below the ranine artery, on the outer side of the expanding branches of the lingual division of the trifacial nerve, under some longitudinal fibres of the anterior part of the stylo-glossus. It has the structure of a salivary gland, and measures from 7 to 10 lines in length, from 3 to 4½ in breadth, and from 1½ to 2½ in thickness. It has, at least, five ducts, which open through the mucous membrane over it by small orifices, each surrounded by a slightly elevated ring; it receives many branches from, and sometimes surrounds, the ranine artery. Dr. Nuhn has at present found the gland in man and the orang alone; he has sought it in vain in many other mammalia; he thinks therefore it may be a mucous gland whose fluid facilitates the movement of the tongue in speaking: [it looks exactly like a salivary gland].

Structure of the Palate.† Dr. Tourtual‡ has detected a new muscle of the posterior nares and palate, and found it regularly in six men as well as in dogs, cats, and sheep. It lies between the mucous membrane and the internal pterygoid plate, before the Eustachian tube, and behind the inferior meatus of the nose. Its upper edge or origin extends from below the palatine process of the turbinated bone backwards and upwards, towards the upper margin of the Eustachian tube; in this line the muscle arises from the vertical plate of the palate bone, and from the internal pterygoid plate of the sphenoid, reaching sometimes to the cartilage of the Eustachian tube; hence its fibres straight descend, and are augmented by others arising from the several parts near which they pass; and going just behind the hard palate, they enter the anterior and outer part of the soft palate, in which they expand on an aponeurosis, mingling with that of the circumflexus palati. The posterior margin of the muscle is usually confused with the anterior fibres of the levator palati, and is covered by a short fold of mucous membrane, which forms the anterior margin of the orifice of the Eustachian tube.

The discoverer proposes for this muscle the name of pterygo-palatine, or levator palati mollis anterior seu minor.§ It receives a (probably sensitive) filament from the internal palatine branch of the fifth; and has, probably, also motor fibres from the glosso-pharyngeal. The function of the pair of muscles is probably that of elevating and of slightly stretching transversely the *anterior* and lateral parts of the soft palate, for which the larger and posterior levatores palati do not provide. In this tension of the palate they probably prevent the anterior fibres of the circumflexi from drawing the anterior part of the palate backwards. They probably are important in sounding the palatine consonants, and their posterior portions may assist the greater levatores palati in narrowing the Eustachian orifices.

Structure of the Liver. An elaborate anatomy of the liver, with measure-

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* Ueber eine bis jetzt noch nicht näher beschr. Drüse im innern der Zungenspitze; Mannheim, 1845, 4to. I supposed he had discovered these glands, but Schlemm (Müller's Archiv, H. v, 1845) shows that they were discovered by Blandin, and decribed in his Anatomie Topographique, p. 175; Paris, 1834.

† On the Structure of the Teeth; see, in a future part, Prof. Owen's account of their development.

‡ Müller's Archiv, 1844, Heft v, p. 452.

§ This name had better be used; for the former has been already applied to what is probably a part of this muscle, arising from the hamular process of the pterygoid plate, and mingled with fibres of the pterygo-pharyngeus. See Haller, Elem. Physiol. t. vi, p. 80, note *t*.

ments of all its measurable parts, is published by Theile.* He confirms Mr. Kiernan's account of its lobular structure; for though he admits that the investment of each lobule, which is so dense in the pig and some other animals, may be absent or very thin in the human liver, yet he urges, and very rightly, that the latter is, by the arrangement of its vessels, divided into lobules, just like those of the pig and others. For in the human liver, as in theirs, each portion thus bounded by vessels, if not by a distinct capsule, is a miniature liver, having in itself a complete bile-secreting apparatus. He confirms also the account of the hepatic cells being arranged in networks with a radiated plan; but he denies the existence of the vaginal branches and plexuses of the portal vein as described by Mr. Kiernan. These vaginal plexuses, he says, " are derived, not from the portal veins, but from the hepatic arteries, from which they are completely filled when both arteries and veins are at the same time injected; and when they appear to be injected from the portal vein, it is because the injection has passed through those vessels by which the blood of the hepatic artery is carried to the portal vein. The interlobular portal veins are therefore, he says, derived directly from the portal veins; and those which appear to be vaginal branches of the portal vein are its *internal roots*, by which it receives the blood which has served for the nutrition of the hepatic ducts and other vessels of the liver. But that which is most new in his essay is the account of the glands of the biliary ducts. The orifices of these are, as Mr. Kiernan showed, arranged in two opposite rows through the whole extent of the ducts within the liver, as far as they can be dissected; an arrangement peculiar to the human liver. Their number is less in the human than in the other livers which Theile examined, but their form is more complex. They generally consist of an elongated tortuous canal, bearing alternate small sacculi and pedicled bunches of cellules; reminding one of the Meibomian glands. These canals, moreover, branch, and their branches anastomose with one another, and with those of the adjacent glands. Such a net-like connexion of the gland-canals occurs within the Glisson's capsule, investing the larger and middle-sized hepatic ducts; but it is most remarkably developed in the transverse fissure of the liver. Here, after the hepatic duct has been well injected, red streaks, forming plexuses, can be seen, which are nothing but large examples of these glands.† The canal-shaped glands in this situation are a quarter of a line in diameter, (in other parts they are from one fifth to one tenth); their walls are beset by pouches and bundles of sacculi, some of which are one sixth of a line in diameter, and there open into them at short intervals elongated glandules, just like those found in the prolongations of Glisson's capsule, except in that they do not open directly into the hepatic ducts.

Krause‡ suspects that these glands of the hepatic ducts, as well as the vasa aberrantia of Weber, are incompletely injected bile-ducts, [or, perhaps, they should rather be considered as such ducts imperfectly developed; for if Krause's account of the acinous structure of the liver be true, no line of essential distinction could well be drawn between them and the more perfect ducts]. He holds still§ that all the bile-ducts have acini at or near their ends, having confirmed his opinion by recent numerous injections. He agrees generally with Kiernan and Weber's account of the reticular arrangement of the minutest hepatic ducts, having often seen this by injection; and he adds that, on many of those ducts he has injected, and has seen, after dissolving the injection that was in them, regular round and oblong vesicles or acini, from $\frac{1}{730}$ to $\frac{1}{480}$ of an inch in diameter; many of these acini, grouped upon their several ducts, compose each lobule, each group of acini having one duct, and therefore each lobule having probably several ducts, or roots of the hepatic

* Wagner's Handwörterbuch der Physiologie, art. Leber.

† E. H. Weber has described these as a part of the vasa aberrantia of the hepatic ducts, similar to those in the left lateral ligament and some other situations. See last Report, p. 29.

‡ Müller's Archiv, Heft v, 1846.

§ His former paper is in Müller's Archiv, 1837; and the same account is given in his Handbuch der Anatomie.

ducts, which proceeding from it enter into the lobular plexus of ducts. He says also, that the acini may often be discerned entire at the edges of very thin sections of the human liver; they appear within the lobules as regular, round, or oval, yellowish-gray and very thin-walled corpuscles or cells, invested by very fine and short fibro-cellular fibrils, and each containing from six to eight hepatic cells, with, in many cases, bile.

M. Natalis-Guillot* has also, (if I rightly apprehend his expressions), confirmed by injections the account given in the last Report of the retiform arrangement of the minutest bile-ducts. These, he says, surround, either in a net, or in dense tufts, the whole surface of each lobule, and spread over the surface of each of the "ultimate ramifications of the vena portæ," i. e. of the interlobular portal veins. The ducts themselves, he thinks, are surrounded by minute branches of the hepatic artery.

PROPERTIES OF THE DIGESTIVE FLUIDS. *Saliva.* Experiments by M. Magendie† and others on the saliva of the horse have shown a difference between that secreted by the parotid gland and the mixed saliva from all the glands. The parotid saliva obtained from a fistula into the duct is more alkaline than the rest [as Mitscherlich also showed]. It contains carbonate [?] of potass which the rest does not contain, and a much larger proportion of ptyaline and albumen, the latter constituting one fifth of the whole solid mass. The parotid saliva also has no influence on starch-paste or raw starch, at a temperature from 104° to 167°; but the mixed saliva speedily transforms the starch-paste into sugar at 104°, and at the same temperature acts slowly but evidently on raw starch and coagulated albumen. This mixed saliva, obtained from food, masticated and swallowed into the œsophagus, is not limpid and clear like that from the parotid, but yellowish-gray, easily becoming turbid. It is weakly alkaline, and contains no carbonate, but abundant alkaline chlorides. There is a great "analogy" between the different kinds of saliva poured into the mouth of man, and those just described as secreted in the horse.

Gastric Fluid. The researches of M. Blondlot,‡ from which he deduced the presence of an acid phosphate of lime in the gastric fluid, are partly confirmed and partly opposed by those of Dr. R. D. Thomson.§ Thus, like Blondlot, he has never found a volatile acid in the stomach if digesting animal food alone; and he disproves the presence of hydrochloric acid in the gastric fluid during the digestion of either kind of food. But, contrary to Blondlot, as well as to the experiments next mentioned, he says, that the acid of the stomach can be saturated with chalk; and that therefore it cannot be an acid phosphate of lime. What the acid is, his experiments leave uncertain; but in the digestion of vegetable substances, he finds a volatile acid always present in very minute quantity, and a fixed acid which, he says, resembles the lactic more nearly than any other.

MM. Bernard and Barreswil hold that the gastric acid is the lactic. Their experiments,‖ like those of M. Blondlot, show that it cannot be either the acetic or hydrochloric—the first cannot be distilled from it; and, though the second can, yet it is only at the last, when the chloride salts are decomposed by the acid really present. Moreover, a minimum of oxalic acid produces a precipitate of oxalate of lime, which it could not do if even $\frac{1}{2000}$ of free hydrochloric acid were present. But they show that M. Blondlot failed to observe effervescence on adding carbonate of lime to the gastric fluid, because of the state of dilution of the fluid: when it is concentrated by evaporation distinct effervescence ensues. This effervescence proves the existence of some acid besides the phosphoric; yet, since the addition of an excess of carbonate of lime cannot completely neutralize the acid, it is highly probable that a small

* Comptes Rendus, 18 Novembre, 1844.
† Archives Gén. de la Médecine, Nov. 1845, from the Acad. des Sciences, 20 Oct.
‡ See last Report, p. 24.
§ On the digestion of vegetable albumen, &c. Philos. Mag., May, 1845; and Lancet, May 17, 1845.
‖ Comptes Rendus, 9 Decembre, 1844.

proportion of phosphoric acid free, or in an acid salt, is present in the gastric fluid and gives it part of its acid reaction. The other acid with which the carbonate of lime effervesces is, the authors believe, the lactic; and they show that in every essential respect the conduct of the gastric fluid with various tests is similar to that of water acidulated with lactic acid, and with the addition of a little chloride of sodium.

The experiments also of M. Melsens* confirm some of these, proving that both marble and other carbonates of lime lose weight when immersed in gastric fluid, and that there must therefore be a free acid in it.

Bile. The most careful examinations of the urine and blood of a patient with intense jaundice did not enable Scherer† to detect in either of them, a trace of any constituent of bile except the colouring matter and cholestea- rine. In evidence of the speedy transformation which the biline would probably undergo in the blood, he mentions that in a large quantity of green fluid vomited, and containing abundant biliary colouring matter, he could not detect a trace of the biline which it must previously have contained. In the same essay he gives an accurate account of his analysis of the biliary colouring matter which he collected from the patient's urine.

The conclusion respecting the non-existence of the essential principles of the bile in the fæces is confirmed by the delicate test for bile invented by Pettenkofer.‡ To the fluid supposed to contain bile $\frac{2}{3}$ of its volume of sul- phuric acid are added by drops, that the temperature may not rise above 140° F., and then from two to five drops of a solution of sugar (one to four parts of water). Presently a reddish violet colour appears, intense in direct proportion to the quantity of bilic acid. By this test no bile (except the co- louring matter) could be found in healthy fæces; but the fæces of diarrhœa and those discharged after purgatives contain complete bile. So also, by this test, bile could always be found in the urine of the pneumonic.

Dr Redtenbacher§ has found that taurine contains 26 per cent. of sulphur, and his discovery is confirmed by Dr. Gregory.||

Pancreatic fluid. Twenty-eight grains of the pancreatic fluid of an elephant, collected eight days after death, yielded to Professor Bergmann,¶ of Bonn, 92·77 per cent of water and 7·33 per cent. of albumen, caseine, and a minute quantity of chloride of sodium and carbonate of soda.

DIGESTIVE PRINCIPLES. MM. Barreswil and Bernard** also maintain that the active organic digestive principle (presently again to be mentioned) is the same in the saliva, the gastric fluid, and the pancreatic secretion; and that the special action which it appears to exhibit in these several fluids is due only to its being combined with an acid in the gastric fluid, and with an alkali in the others. They say that from whichever of these three sources this prin- ciple is obtained it will, if an acid be added to it, digest meat, gluten, and other azotised compounds, and act like artificial gastric fluid; but if it be made al- kaline it will only be capable of digesting the amylaceous principles, and thus will be an artificial saliva or pancreatic fluid. So also, by making gastric fluid alkaline, it will act like saliva or pancreatic fluid; and by making either of the latter acid it will act like gastric fluid.

PROCESS OF DIGESTION. The principal researches of the year to be placed under this head have had reference to the digestion of the saccharine and amylaceous principles of food. The most considerable are those of MM. Bouchardat and Sandras,†† whose results are as follows:

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* Comptes Rendus, 9 Decembre, p. 1289.
† Annalen der Chemie und Pharmacie, Marz, 1845; and Lancet, May 24, 1845.
‡ Annalen der Chemie u. Pharmacie, No. lii, p. 90.
§ Annuaire de Chimie, p. 724, from the Comptes Rendus, t. xx, 1845.
|| Outlines of Chemistry, Part ii, p. 566.
¶ Oesterr. Med. Wochensehr., Dec. 14, 1844, from the Med. Corresp. Blatt Rhein. u. Westphal. Aerzte, No. 17, 1844. Much more concerning the nature of the pancreatic fluid will be found in the following paragraphs.
** Gaz. Méd., 12 Jul. 1845, from the Report of the Acad. des Sciences, 7 Jul.; Comptes Rendus, 25 Jul.
†† Report from the Académie des Sciences, 20 Jan. 1845, in the Gazette Médicale, 25 Jan. 1845.

When cane-sugar is given to dogs it is found, either unchanged or converted into *sucre interverti* or lactic acid, in the whole length of the digestive canal. After it has been given for several days it may be found in the urine, and in the bile, blood, and chyle. When cane-sugar is introduced directly into the blood it passes into the urine; but when the same quantity of *sucre interverti* or lactic acid, was so introduced none was detected in the urine. In order that cane-sugar may be destroyed in the blood (i. e. ultimately reduced to carbonic acid and water), it must first be transformed into *sucre interverti,* or lactic acid in the digestive canal.

Raw starch is very imperfectly digested by men and carnivora. The greater part of it may be found unaltered in the excrements. A greater effect is produced on it by the digestive organs of herbivorous rodents. It undergoes no change in their stomachs; but in the contents of their small intestines (which are always alkaline, except sometimes at the pyloric part of the duodenum) there are found, together with entire starch granules, others that are cracked, eroded, or almost wholly destroyed; and, also, dextrine with traces of grape-sugar. The cæcum contains an acid paste, in which there are some entire starch granules, dextrine, grape-sugar, and lactic acid. The same materials are found in the rectum. The dextrine, grape sugar, and lactic acid may also be detected in the blood and the bile, but not in the urine of these animals; and the blood of their vena portæ contained more water and more of these three substances than their arterial blood did—making it sure that they are absorbed by the blood-vessels, not by the lacteals.

Graminivorous birds digest raw starch more completely than mammalia do. It undergoes no change in their crops; and in their gizzards, though there are traces of dextrine and grape-sugar, yet nearly all the starch-granules appear unchanged. In the small intestines the starch-granules are gradually more and more destroyed, and ultimately they undergo the same changes as in the intestines of the herbivorous rodents, but more completely. In both, the authors consider the changes to be due to the high temperature, the alkaline reaction, and the presence of a secreted principle which acts like diastase, only with less energy: all which conditions exist in greater force in the birds than in the mammalia.

When the starch-granules have been burst by cooking they are digestible by men and carnivorous animals. Their solution commences in the stomach, and is slowly continued through the intestinal canal. The products are dextrine, grape-sugar, and lactic acid; which are found mixed with some starch remaining unchanged.

If more than a certain proportion (one gramme, at the most, for an adult dog) of a feculent or saccharine principle be mingled at once with the blood, sugar is always eliminated by the kidneys. Hence the slow introduction into the blood of the products derived from the digestion of these principles appears to be an essential condition for their due disposal; and this condition is secured by two chief means, namely, the slowness of their solution, and the chief manner of their absorption. They are formed into soluble compounds in the intestines; and these being absorbed by the blood-vessels, are carried to the liver, where, if combustible matters are in excess in the blood, the greater part of them are secreted and discharged with the bile into the intestines, whence some of them may be absorbed with the other soluble constituents of the bile. "Thus then is established a limited circulation of the combustible matter, which, by this admirable artifice, is only gradually carried into the general circulation."

These conclusions concerning the transformations which starch undergoes in digestion are, to some extent, confirmed by Dr. R. D. Thomson,[*] whose experiments show that dextrine and soluble starch exist in the stomachs of pigs fed on farinaceous food during and for some time after digestion, and

* Philos. Mag., May 1845; and Lancet, May 17, 1845.

that sugar exists in the blood of the same animals in the proportion of from 2·57 to 8·05 grains in 1000 grains of the serum.

In a subsequent memoir* MM. Bouchardat and Sandras state that the principle which, as above-mentioned, appears to act like diastase in the transformations of starch is secreted chiefly by the pancreas. They find the pancreatic fluid of birds transparent, viscid, slightly alkaline, and capable of liquefying starch-paste, and of transforming it into dextrine and grape-sugar. Portions of pancreas cleared of blood and large vessels possess the same power in a very high degree ; and no other organ besides the pancreas, and in a slighter degree the salivary glands, possesses such a power.† It is, moreover, wholly destroyed both in the pancreatic fluid and in the pancreas itself by such influences as destroy the like property in diastase, such as a temperature of 212°, tannin, mineral acids, metallic salts, &c.

The same influence which these authors ascribe to the pancreatic secretion is ascribed by M. Mialhe‡ to the saliva, from which he gives directions for obtaining the digestive principle, *animal* or *salivary diastase*,--by filtering it and then treating it with five or six times its weight of absolute alcohol. The diastase being insoluble in alcohol is thus precipitated in white flocculi. He describes the aqueous solution of this substance as insipid and neutral, not precipitable by subacetate of lead, and when left to itself undergoing a transformation into butyric or some similar acid. With raw starch this salivary diastase requires several days for the production of dextrine and sugar of starch ; but with starchpowder the change is quickly effected ; and with starch-paste it is very speedily completed if aided by a temperature of about 160°.§

The experiments of M. Lassaigne ‖ confirm those of MM. Bouchardat and Sandras as to the properties of the pancreas and its fluid ; and, at least in great measure,¶ those of M. Mialhe on the properties of the saliva. He shows that at the natural temperature of the body saliva has no effect on whole starch, and that mastication does not change the form in which it naturally exists in cereal grains ; that horse's saliva does not act on starch even when its grains are broken ; but that human saliva, though it does not affect raw and whole starch at a temperature of 100°, can even at a temperature of from 64° to 68° convert powdered starch partly into dextrine and partly into sugar of starch ; the envelopes of the granules preserving at the same time their property of becoming violet when touched with iodine.

Influence of the Bile in digestion. Dr. Platner** has made experiments to find how the bile contributes to digestion. He has confirmed, what Simon and others showed, that the fæces contain none of the bile except its colouring matter [and some of its fat?]; and what Purkinje showed, that bile will put a stop to or prevent the artificial digestion of coagulated albumen. On mixing pure artificial digestive fluid, neutralized by carbonate of soda, with bile, no change took place ; but on adding hydrochloric acid to the mixture it became very turbid. The same happened when bile was mixed with digestive fluid not neutralized ; but hydrochloric acid added to bile alone produced no precipitate. The precipitate consisted of bilic acid united with some organic body, perhaps pepsin, explaining probably the fact quoted above from Purkinje.

When bile was added to a solution of albumen in acetic acid, a precipitate

* Archives Gén. de Médecine, Mai 1845 ; Report from the Acad. des Sciences, 14 Avril.

† See in connexion with this subject a paper by M. Bouchardat, " Sur la fermentation saccharine ou glucosique," in the Annales de Chimie et de Physique, Mai 1845, t. 89, p. 61.

‡ Ibid., 5 Avril 1845 ; Report for the 31st of March.

§ According to Dr. R. D. Thompson (l. e.) the transformation of starch into dextrine is effected to some extent by boiling it for half an hour in pure distilled water.

‖ Arch. Gén. de Médecine, Mai 1845, from the Report of the Acad. des Sciences, 7 Avril.

¶ Ibid. Juillet 1845, from the Report of the Acad. des Sciences, 2 Juin. In the earlier paper his results were opposed to those of M. Mialhe.

** Muller's Archiv, 1845, Heft iv. He has since published a special work, " Ueber die Natur und den Nutzen der Galle," Heidelberg, 1845 ; but I have not yet received it. Another work relating to the physiology of the bile is H. Meckel, De genesi Adipis ; Halis. 1845, 8vo, which will be noticed hereafter.

was formed which was insoluble in all acids, but soluble in alkalies. When bile and albumen were mixed and acetic acid added, a precipitate like coagulated fibrine was formed; and a similar precipitate was formed by the agency of even carbonic acid; showing that although the bilate of soda (i. e. the pure principle of bile) retains its composition under the action of either acids or alkalies alone, yet it is decomposed easily by combinations of acids with organic substances. When bile was added to a solution of albumen or gelatine obtained by artificial digestion, precipitates were formed which were soluble in acetic acid and consisted of bilic acid united with the organic substance. Sugar and gum in like circumstances appeared to unite with the fatty matters of the bile.

Fæces. The usual microscopic constituents of human fæces are thus enumerated by Dr. Gobee.* 1. A large quantity of vegetable cellular tissue, with or without epidermis and hairs. 2. Vegetable hairs. 3. Vegetable spiral vessels. 4. Elongated quadrangular plates of light yellow colour in great abundance, of uncertain nature; they are not affected by acetic acid, and are insoluble in cold ether, but iodine displays transverse striæ on them. [Probably they are portions of muscular fibre. I have found such, tinged pale yellow by the bile, in the fluid discharged through an artificial anus.] 5. Large quantities of crystals of phosphate of ammonia and magnesia. 6. Fat-globules or cells in various quantity. 7. A great quantity of granules. 8. Few epithelium- and mucus-cells. 9. Much of the brown-colouring matter of the bile.

ABSORPTION.

Structure of the Lymphatics. The subject of one of Mr. Goodsir's excellent essays† is the structure of the lymphatic glands. At the points of connexion between the extra- and intra-glandular lymphatic vessels, the coats of the former (whether afferent or efferent) separate. The outer coat is continued into the external capsule of the gland, from which processes pass inwards, binding together the substance of the gland, and supporting the vessels within it. The middle, or fibrous coat, is usually nearly lost, as the vessels pass towards the centre of the gland. But the internal coat becomes thicker and more opaque in the intra-glandular lymphatics; and when, in any of these thickened, dilated, and oft anastomosing vessels, it is broken up, it appears composed of two substances; namely, first, a thin transparent membrane, in which ovoidal bodies, containing one or more minute vesicles, are imbedded, as " germinal spots,"‡ at regular distances; and secondly, thick layers of close-packed spherical nucleated particles about 1-5000th of an inch in diameter, which make the vessel appear opaque, and leave only a narrow and irregular canal along its axis, the walls of which canal appear formed by them, not by any membrane lining them. The capillaries in the lymphatic glands ramify in contact with (not in the substance of) the external layer of their coats; as they do on the ultimate ducts of the true secreting glands; and they form as fine a network.

The general result of these observations is plainly favorable to the opinion of an intimate analogy between the lymphatic and the true secreting glands; of which some account was given in the last Report, and more will presently be said in speaking of the glands without ducts.

Process of Absorption. Some observations by E. H. Weber§ are said to prove that the chyle is first absorbed into the epithelium-cells covering the villi, which, at a certain period, are found full of chyle-globules, and from which it is transferred into the proper cells of the villi, to be by them conveyed to the lacteal vessels. And among the cells of the villi, it is said that

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* Kliniek; Tijdschrift voor wetensch. Geneeskunde; voor G. C. Gobée, 1844, St. iv.
† Anat. and Pathol. Observations, No. viii, p. 44.
‡ The expression has reference to the author's general theory of nutrition: the bodies he describes appear to me identical in aspect with the nuclei or cytoblasts of many secreting gland-ducts.
§ Archives d'Anat. Gén. et de Physiol., Jan. 1846.

two peculiarly large ones are often seen in man during digestion, which touch each other, and of which one contains an opaque-white liquid, and the other a clear fatty matter.

Experiments on absorption have been performed by Mr. Fenwick,* and their results are very like those obtained by Herbst. 1. He relates two experiments to show that indigo will pass into the lacteals. 2. He relates many to prove that the lacteals do not absorb strychnia, or milk, or other food, from any part of the digestive canal in which the blood is not circulating. 3. He shows, as Herbst does, the passage of liquor sanguinis and blood into the lacteals when the adjacent blood-vessels are much congested. 4. In other experiments, oily matters (?) and prussiate of potash injected into the pleura of a rabbit were shortly after found in the lacteals. 5. Others again show that the action of the lacteals and lymphatics is independent of nervous influence. 6. And others confirm the fact already known, that they continue to propel their contents after apparent death. 7. From his experiments, from analogy, and from many ingenious, but I think insufficient, arguments, Mr. F. concludes that these vessels obtain their fluid neither by absorption, nor by secretion from the blood-vessels adjacent to them, but by parts of the contents of the blood capillaries, according to the degree of congestion, being directly and mechanically effused into them.

Propulsion of Lymph. An attempt has been made by Dr. Bidder† to determine the average quantity of lymph and chyle which flow through the thoracic duct in a given time. The measurements were made by collecting what flowed from the thoracic duct immediately after death. In five cats, the fluid continued to flow from one to six minutes, and, judging by the quantity collected in this time, the average quantity which would have flowed in an hour, was 373 grains (the extremes being 276 and 480 grains); and the average proportion between the weight of the cat and the weight of the chyle and lymph, which at the same rate, would have flowed in twenty-four hours, was as 5·34 to 1 (the extreme proportions being as 6·8 : 1, and as 5·1 : 1). In two dogs the average rate of efflux (similarly calculated) was 3858 grains in the hour; and the average weight of the dogs was, to that of the chyle and lymph which would have flowed in twenty-four hours, as 6·66 :1. Now, the average weight of blood in cats is, to the weight of their bodies, as 1:5·7; and of dogs, as 1:4·5; hence the quantity of fluid daily traversing the thoracic duct of a cat, is about equal to the whole quantity of blood in it; and the quantity of the same in a dog is equal to two-thirds of its blood.

Lymphatic hearts. Volkmann‡ has proved that the rhythmical movements of the lymphatic hearts of frogs depend on the direct influence of portions of the spinal cord. They cease on the instant of destroying the cord, though those of the blood-heart continue for many hours. But repeated experiments showed that the contractions of the anterior hearts would continue long while they retained a nervous connexion with the cord about the third vertebra; and those of the posterior hearts as long, if their connexion with the cord at the eighth vertebra was uninjured. The movements thus continued in the lymphatic hearts though the whole of the cord, except these portions, were destroyed; and on the instant of destroying either of these portions, though all the rest of the cord were intact, the movements of the corresponding hearts ceased. Removal of the brain had no influence. The movements continued also after the division of the posterior spinal roots (they were therefore not reflex), but they ceased directly on the division of the anterior roots.

* Lancet, Jan. 11, 18, 25, Feb. 1, 1845.   † Muller's Archiv, 1845, Heft i.
‡ Ibid. 1844, Heft iv, and Wagner's Handworterbuch, art. Nervenphysiologie, p. 489. Valentin, in the body of his Physiologie (vol. ii, p. 767), denied the truth of these experiments, but in a later appendix confirms them. For other papers on the lymphatics, see Oesterlen, as presently quoted; H. Nasse, an elaborate article on the lymph in Wagner's Handworterbuch; and papers on some unusual arrangements of the lymphatics, by Svitzer and von Patruban, in Muller's Archiv, H. ii, 1845.

GLANDS WITHOUT DUCTS.

In the last Report I deferred the notice of Dr. Oesterlen's observations[*] on the vascular glands that I might include with it that of the then unpublished essays of Mr. Simon.[†] I am thus able to set out more briefly the results of the two most important works ever yet published on these organs, and this with advantage even to Dr. Oesterlen's work, for his facts gain importance and clearness by the corroboration and bright illustration which they receive from the truly admirable researches of Mr. Simon.

Thymus Gland. According to Mr. Simon, the earliest condition of the thymus gland is that of a simple tube of transparent homogeneous membrane, with granular and dotted contents. It presents at regular intervals elongated thickenings of its wall, which are probably the attenuated nuclei of a series of primordial cells, by the fusion of which the tube may be first formed. The tube has no connexion with the respiratory mucous membrane. In the next stage the tube (which remains in the axis of each half of the gland as its central cavity,) bulges at certain points of its length, forming diverticula or follicles, which communicate with and have the same structure and contents as itself. These usually assume hemispherical or pedunculated forms ; and, in the next stage, themselves branch or form secondary and tertiary bulgings ; and this is generally effected without elongation of the isthmus or pedicle by which the primary follicles were connected to the main canal, so that the secondary ones appear sessile. The progress of the development of the gland consists in repetitions of this process—the growth of follicles extends successively to all parts of the main tube ; in each new crop of follicles are repeated the same acts of development and branching ; and the whole substance of the gland enlarges by interstitial growth.

The gland continues growing through the whole " age of early growth ;" and the period at which it attains its greatest size cannot be more nearly determined than the age of completed growth of the whole body can. Mr. Simon's observations on this point agree with those of Haugsted.

This account of the development, affords some notion of the mature structure of the thymus. According to both Simon and Oesterlen, whose observations now begin to coincide, it consists of a collection of polygonal mutually flattened membranous cells, from half a line to nearly two lines in diameter, the terminal vesicles or follicles of the gland. These are ranged in masses round a common axis ; each mass forming a sort of cone, whose apex is directed towards the axis. The vesicles or cells are not completely close and separate, they are closed in about three fourths of their periphery ; by the remaining part, each is attached to the general trunk of the glandular substance and opens into some diverticulum of its common cavity.

The walls of the vesicles are formed by the same kind of homogeneous membrane as the primitive tube ; each having on its exterior a capillary network ; groups of them are connected by investing areolar tissue, in which is mingled a small proportion of delicate elastic fibrils.

The vesicles are filled by a fluid and a multitude of corpuscles. The corpuscles, according to both observers, have the structure and relations of nuclei. They are generally circular, yet often deviate widely and variously from this form, and are flat and disc-like. Their average diameter is $\frac{1}{3800}$ of an inch ; they are characteristically dotted, having from two to five very small dark spots, either scattered, or collected into a single corpuscle in their centres. In animals past the most active period of the thymus, there may be found cells in which these dotted corpuscles appear as nuclei, and which are, or become, perfect fat-cells.

* In his Beitrage zur Physiologie ; Jena, 1843, 8vo, pp. 1-95.
† A Physiological Essay on the Thymus Gland ; London, 1845, 4to ; and, The Comparative Anatomy of the Thyroid Gland ; in the Philosoph. Transactions, 1844, part 2.

The fluid of the thymus-cells contains (in the active period) proteine-compounds and traces of fatty matter; and the gland itself, on ultimate analysis, yields nearly the same proportion of essential elements as blood and flesh do.

The most important facts afforded by the comparative anatomy of the thymus, laboriously investigated by Mr. Simon are, 1st, that it "belongs, without exception, to all animals breathing with lungs, and to no others." 2. That in the hybernating rodent animals, the large persistent thymus and its prolongations into large masses which lie in the posterior mediastinum, are wholly composed of fat, the nuclei or cytoblasts which its cells contained having, at the approach of the hybernating period, genuine fat-cells formed round them. 3. That the thymus of birds, hitherto unknown, is a semitrans-parent ampullated tube, following the line of the superficial cervical vessels, and very early ceasing to discharge its functions. 4. That in reptilia, to which also a thymus was generally denied, its existence is constant. In the hybernating serpents also there is always appended to the persistent thymus, an accessory organ or fat-body. In the batrachia and some others, the thymus is at a very early period converted into a mass of fat, which is persistent. The larvæ of batrachia while breathing with gills have no thymus; its development begins as soon as their pulmonary respiration is established. Among the icthyoid reptiles with persistent gills, it is found in the menopoma, amphiuma, axolotl, and menobranchus, but not in the siren and proteus. 6. In fishes, a thymus is not found.

Thyroid Gland. According to Mr. Simon, the thyroid gland consists of a dense aggregation of completely closed vesicles, each formed by a layer of delicate homogeneous membrane (*limitary membrane*), invested by a close capillary network. These are the analogues of the cells or follicles of the thymus, but they are completely closed, and do not communicate with any central cavity. They are filled by fluid and cytoblasts, which are the analogues of those in the cells of the thymus : and are held together by fibro-cellular tissue. The cytoblasts are not materially different from those of the thymus ; in the young animal they lie close together on the inner surface of the containing cell, like, Oesterlen says, " a tesselated epithelium ;" but from this position they detach themselves and float freely in the fluid of the cavity. That they have the relation of nuclei is proved, according to Mr. Simon, by their being not unfrequently found as the nuclei of cells, about $\frac{1}{1100}$ of an inch in diameter. He shows also that a thyroid, or an organ representing it, exists in all vertebrate animals, appearing to have relation to the development of their nervous centres, always maintaining an intimate relation to the vascular supply of the brain, existing in certain fishes as a mere diverticulum to the cerebral circulation, and in the animals above them having a super-addition of glandular structure.

Spleen. Oesterlen and Mr. Simon agree that the Malpighian bodies of the spleen are not vesicles, but aggregations of cytoblasts (analogous to those of the vascular glands already described) which are herein collected in small bodies; but these have no inclosing cell wall; each lies within a kind of capsule of capillary vessels, receiving themselves no vessels into their interior. They are held together by an amorphous transparent substance with obscure fibres ; among which Oesterlen believes he once detected lymphatic vessels. He has not always found the Malpighian bodies in any of the animals in which he has examined them. Most of the corpuscles or cytoblasts of the spleen, whether scattered through its red substance, or collected in the Malpighian bodies, appear like those of the thymus, but they vary in their contents ; others are larger and are merely close-pressed aggregates of granules; others are partially surrounded by darker granules; and others, in different species, differ from all these, approaching the characters of blood-corpuscles.

Renal Capsules. Oesterlen has described the structure of these more mi-nutely than that of any other vascular gland. He finds inconstancy in the distinction, proportions, and colours of the cortical and medullary substances. His account of the blood-vessels accords with Müller's. He finds no central

cavity (except that of the great central vein); but, occasionally, hollow, elongated spaces of conical shape, which have no lining membrane, and are empty, or contain a thick grayish-white fluid. The appearance of radiating striæ in the cortical substance of these organs is due to groups of the small corpuscles or cytoblasts of which these, like the other vascular glands, are chiefly composed; and of which, in these, many are grouped together with fat-cells and molecules in the form of nearly parallel cylinders or elongated cones; each group being, as. Mr. Simon has discovered, inclosed in a tube of very delicate membrane. The medullary substance of the renal capsules, and that which intervenes between the tubes full of corpuscles consist, according to Oesterlen, of cytoblasts, uniformly scattered, and with these are mingled minute molecules, and small collections of fat-cells or particles.

The various microscopic objects found in the renal capsules are, according to both Oesterlen and Simon—(*a*) minute oil or fat particles, either scattered or grouped in round, oval and retort-shaped flattened masses; (*b*) similar groups of fat particles collected round the proper cytoblasts of the organs, but devoid of separate cell-walls; (*c*) the cytoblasts, pale, roundish or oval, disc-like, or more commonly, concavo-convex : some have but the appearance of a nucleolus; in others it is distinct, central, or scattered, or marginal; (*d*) similar cytoblasts surrounded by oval cells; (*e*) four other forms are enumerated by Oesterlen, which are probably only varieties of the preceding.

The preceding statements justify the conclusion drawn by both the authors that these four organs are so similar, that they may be classed as members of one order. To say nothing of their likeness in obvious characters, the essential constituents of all, their peculiar corpuscles, are similar in all, though admitting of distinction in their best marked states. In all, these corpuscles have the relation of cytoblasts or nuclei. In all, some of them are collected in groups of definite, though various form; which groups are in all except the spleen, inclosed in vesicles or tubes formed by delicate membrane, (primary, limitary, or basement membrane), the exterior of which is covered by capillary blood-vessels.

Oesterlen, who cites, besides these analogies, many others of less importance, includes, in the same class with these four organs, the lymphatic glands, the pineal and pituitary glands, the choroidal gland in the eye of fish, and the greenish gland on each side of the gastric sac in crabs, and suspects that many structures in invertebrata will be brought into the same class. In the lymphatic glands he finds, besides those of the lymph, a variety of corpuscles like those in the renal capsules. They may be generally distinguished into two kinds; viz., fat cells and molecules, as in the renal capsules, and the cytoblasts [which, doubtless, are the same as those composing the layer of granular matter described by Mr. Goodsir]. These cytoblasts are various, but the majority cannot be distinguished in any way from the cytoblasts of the thymus. Moreover, Oesterlen says that he has found, in an inguinal gland of a fœtal calf, gland-vesicles like those of the thymus, parotid, &c., formed by transparent membrane, with traces of capillary network on it, and full of cytoblasts, with which fat-molecules and fat-cells are mingled.

Oesterlen describes a very similar structure in the pituitary gland : and he says the pineal gland is similarly composed.

But to know the number of organs which may be included in this class or family, is less important than to determine to what other class of organs they are in nearest relation. It is clear that (as many have believed, but none have proved), they are, in all essential characters, *glands,* and that the name of either vascular glands, or glands without ducts, is appropriate to them. Their chief analogies to the true glands are seen in (*a*) the constant possession of cytoblasts, or nuclei, analogous to the nuclei of the true gland-cells; for even in the latter it is probable that the nuclei, rather than the cells, are the most active and essential apparatus; (*b*) the general existence of the structureless (limitary) membrane inclosing the cytoblasts, as the membrana propria of the true glands incloses the secreting cells (the spleen in which it is absent having perhaps its analogue in the liver among the true glands); (*c*) the arrangement

of the capillary vessels on the exterior of the vesicles or other collections of cytoblasts in the glands without, just as in those with, ducts. Thus, the glands without ducts possess all the apparatus which, in the true glands, is provided for secretion. They differ from them in that the formation of cells around their cytoblasts is exceptional, and that their secretion is poured into closed cavities, not into open canals.

Assuming then, that the common occupation of these organs consists in withdrawing from the blood some material which they may (probably after some elaboration) discharge into it again,—the next question is,—What is more particularly the function of each of these glands? In answer only one thing is proved; Mr. Simon's observations prove that in the hybernating animals the thymus forms in itself a store of fat, to be consumed in the maintenance of the temperature during hybernation; and this is more than ever yet was proved of any of these glands. His and former observations also render it highly probable that in other than the hybernant animals, the thymus, during all its temporary existence, is occupied in sequestrating some material from the blood to be restored to it again, in the same or (more probably) some other form. He believes that this material is always such as may be consumed in the service of respiration, " the thymus gland fulfilling its use as a sinking fund in the service of respiration." [But the evidence appears to me insufficient for this conclusion, or even opposed to it; for when in hybernation the gland performs this function, and performs it in the highest degree, it is temporarily adapted for it, not by temporary development, but, as all the analogies of the formation of fat in other cases show, by temporary degeneration. The formation of an extraordinary quantity of fat in any part expresses a defective nutrition of that part; and when the thymus of hybernants accumulates fat at the approach of their winter sleep, it is probably rather because some process in general nutrition to which it before ministered is ceasing, than because it is now about to discharge in an extraordinary degree its ordinary function. I should regard the fatty degeneration or fatty atrophy of the thymus at the approach of each winter-sleep as an annual recurrence of a process analogous to that atrophy by diminution or total removal of substance which takes place once for all in the animals in which the thymus is not persistent. In each case the atrophy is an indication that the necessity for the ordinary acts of the thymus has ceased; but in the hybernants it is for new circumstances made to minister to a new purpose, till, at the cessation of the winter-sleep, and the recommencement of new growth, it begins again to be truly developed, and to form the more highly organic azotized compounds which it may restore to the blood for the nutrition of the fresh-growing tissues.]

For the thyroid gland, Mr. Simon believes (chiefly on the evidence of its comparative anatomy), that it supplies, in its simplest state, a vascular diverticulum to the stream of the cerebral circulation, and that in its higher development, its secretion bears some essential relation to the nutrition of the brain, such that, for instance, while the brain is at rest it may be separating from the blood the same materials as the brain in action takes from the blood.

In like manner he holds the spleen to be as a diverticulum to the systematic circulation when the vessels are filled after taking food; and, by the secretion of the Malpighian corpuscles, an organ in which nutritive matter may be stored up till the system needs it. And, lastly, he thinks the renal capsules may have with the generative system some such relation in alternating secretion as he supposes the thyroid gland to have with the brain.

In the place of these several theories, Oesterlen, in a long discussion, enunciates but one, and that not a new one; namely, that the acts of the glands without ducts are the taking of fluid from the blood, from which as a cytoblastema their cytoblasts are formed; and that these, after their completed development, liquefy and restore to the blood a material more fitted for nutrition than that which it gave for them. [And indefinite and incomplete as this theory is, I must confess it appears to me to express all that can as yet be considered very probable in the general physiology of the glands without ducts.]

REPORT ON THE PROGRESS

OF

HUMAN ANATOMY AND PHYSIOLOGY

IN THE YEAR 1844-5.

PART II.

NUTRITION.

In its Chemical Relations.—Formation of Fat. I cannot find, in the long course of experimental pig-fattening described by M. Boussingault,[*] anything that is both new and interesting to human physiology. He and M. Persoz[†] who has fattened geese, do not appear to have found out more than was already known, namely, that the presence of fatty matter in the food is not essential to the formation of fat in the body; and that a certain quantity of nitrogenous principles in the food is essential to that end; the mere truth being that for an animal to grow soundly fat it must be in tolerable health, and that for this it must have some of its natural diet.

In relation to the well-proved formation of fat from the saccharine principles of the food, an interesting observation is made by H. Meckel.[‡] He finds that when grape-sugar and bile are mingled fatty matter is formed from the former; thus, in his chief experiment, performed under the guidance of Marchand, 440 grammes of ox-bile were divided into four parts: the first, while recent, was treated with ether; the second was so treated after exposure for twenty-four hours to the heat of an incubating machine; to each of the third and fourth portions, there were added 4 grammes of grape-sugar obtained from starch; and the third was exposed for five hours, and the fourth for twenty-four hours, to the heat of the incubating machine. Then, from these third and fourth portions, all the fatty matter was extracted by ether. The quantities of fatty matter thus obtained were, from the first portion, ·48 grammes; from the second, ·54; from the third, ·87; from the fourth,

[*] Annuaire de Chimie, 1846, p. 789, from the Ann. de Chimie et de Physique, t. xiv.

[†] Report from the Acad. des Sciences, 16 Decembre, 1844, in the Gazette Médic., 21 Decembre. Three of the principal papers on the formation of fat, by MM. Edwards, Boussingault, and Persoz, which have been noticed in the last two Reports, are fully reprinted in the Annales de Chimie et de Physique, Août, 1845. They are all admirably criticised by Liebig, in the Annalen der Chemie und Pharmacie, Juni 1845; and in the Lancet, of the same month.

[‡] De Genesi Adipis in Animalibus; Halis, 1845, 8vo. I did not obtain this treatise in time to mention the fact as a contribution to the physiology of the liver.

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1·84. The much larger quantity of fatty matter in the third and fourth portions can be assigned only to the sugar which was added to the bile; and the greater quantity in the fourth than in the third appears to show the gradual progress of the transformation, which was not completed in the last portion even after twenty-four hours; for sugar unchanged could still be detected in it.

It is thus made probable that the process of transformation of the amylaceous principles of the food into fat consists in their being, first, by the saliva and pancreatic-fluid, transformed into grape-sugar, of which some is converted by the bile into fatty matter in the intestines, and the rest, absorbed by the vessels leading to the portal vein, is carried in its branches to the liver, and therein is also converted into fatty matter. This is confirmed by an experiment of Trommer, who, having fed animals on grape-sugar, detected it in the blood of the portal vein, but not in that of the hepatic veins. Neither is it impossible that a similar series of transformations should be effected in carnivorous animals; the gelatine of their food being, perhaps, converted into sugar of gelatine, and this into fatty matter.

Quantity of Nitrogen in Food. Drs. Schlossberger and Kemp[*] have constructed a table of what they suppose to be the comparative proportions of nutriment in our several organic aliments; but it is scarcely more than a table of the comparative proportions of nitrogen in them. It is too long to be extracted, and cannot be analysed.

Proportions of Elements discharged in the Excretions. Some experiments on chickens, by Dr. Sace,[†] show the respective quantities of the elements of their food which are discharged by the cloacal excrements, and by transpiration. Two chickens consumed in a week, in barley, chalk, and sand, 211·544 grammes of carbon, 30·1551 of hydrogen, 10·6123 of nitrogen, 197·468 of oxygen, and 15·4695 of substances which would have remained as ash after combustion; and their cloacal excrements yielded of carbon 50·3946 grammes, of hydrogen 6·7275, of nitrogen 4·3524, of oxygen 45·9836, and of inorganic matter remaining as ash 121·6128. Their joint increase in weight was 19·18 grammes; allowing for this, the quantities of the several constituents which were transpired and retained in the tissues may be easily reckoned.

NUTRITION IN ITS RELATIONS TO STRUCTURE.

Theory of Cell-Development. A very lucid exposition of this theory, and of the principal facts concerning the history and nature of the nucleated cell in the structures of animals, has been published by Kölliker.[‡] The subject has also been thoroughly discussed by Reichert[§] in his 'Report on the Progress of Microscopic Anatomy in 1843,' his observations being included in an examination of essays by Karsten,[||] Kölliker,[¶] and Nägeli.[**] The general tendency of the whole is to show that we are yet very far from the knowledge of the true mode of development of the nucleated cell in animals. There is indeed in all these essays, as well as in the personal knowledge of most anatomists, an abundance of facts bearing upon the subject; but many, perhaps

[*] Lond. and Edinb. Philos. Mag., Nov. 1845; Medical Gazette, Dec. 12, 1845; and Annalen der Chemie, Oct. 1845.

[†] Annalen der Chemie, Oct. 1844. He seems to think his experiments show what proportion of food is assimilated, and what is at once excreted without being first assimilated; but they do not do this.

[‡] In Schleiden and Nägeli's Zeitschrift, Heft ii, 1845; another part is announced for publication, but I have not been able to obtain it.

[§] In Müller's Archiv, 1844, No. vi. Jahresbericht, pp. 148-172.

[||] De Cella Vitali; Berol. 1843. See last Report.

[¶] Entwickelungsgeschichte der Cephalopoden; Zurich, 1844.

[**] Zur Entwickelungsgeschichte des Pollens; Zurich, 1842; and in Schleiden and Nägeli's Zeitschrift für Botanik, 1844, Heft i.

the majority, of these facts cannot be brought within the expressions of Schwann's theory of cell-development; neither can there be yet traced in them any single, uniform, and constant mode of development of the nucleated cell. From the very nature of the case, it seems most probable that one law and one mode must be always observed in the development of the cell and its parts; if it be so, the one mode is unknown; if it be not so, then, in the place of the fair and comprehensive system of Schwann we have a crowd of unconnected facts such as no memory can contain, and of which it would be useless, even if it were possible, to give a brief report.

The observations of Reichert, as well as those in the other works just referred to, relate only, or principally, to the genesis of the nucleated cell and its several parts; and he implies that there is much less room for doubt concerning the metamorphoses of the cell itself, by which, of it or through it, all the more highly organized animal tissues are supposed to be formed. It appears to me, however, that we can be as little sure of many of the changes which nucleated cells are said to pass through in the formation of other tissues, as we are of the process by which the cells themselves are formed. The development of all the fibrous tissues appears especially doubtful. For the investigations of every year show the great difficulty or impossibility of confirming the observations by which Schwann explained the development of these and some other tissues, and the equal facility of finding appearances which cannot be reconciled with his theory, or any other single theory yet proposed concerning it.*

I have found ample reason for expressing these doubts of the sufficiency of the accepted theories of development in recent examinations of tumours and other morbid growths. Their structure seems peculiarly adapted for testing a theory of cell-development; for they are, doubtless, obedient to the same general laws of formation as the healthy structures are, and, in the unequal and often rapid growth of their several parts, it could hardly happen but that in many specimens all the phases would be seen through which their structures pass towards their fully developed state. But in very numerous examinations I have not found a single example in which a cell has appeared to be forming or formed around a pre-existing nucleus; or one in which fibres have appeared to be formed out of nucleated cells; or one in which nucleated cells have appeared to constitute a stage towards any form of higher development. On the contrary, I have found many instances of rapidly growing structures composed of large collections of fibres without a nucleated cell among or near them; others with abundant nucleated cells, but scarcely any free nuclei or granules, and nothing like a cell incompletely developed round its nucleus; and, again, others (and these of especially rapid growth) with no cells at all, but composed almost entirely of corpuscles like nuclei or cytoblasts.

From these and other observations I am disposed to think that the ordinary (and not the exceptional) mode of development of fibres is, not through nucleated cells, but from a structureless or dimly granular substance which is first *marked*, and then broken up, into fibres. There is good evidence that the cytoblasts which are usually or always imbedded in this substance, influence the development of the fibres; and though I cannot tell how they do so, yet it is certainly not by conversion of themselves into fibres; they shrivel and disappear as the fibres increase and become more perfectly formed.

I think it will be found that, in morbid growths, the nucleated cell is always a terminal, not a transitional, form; for in certain tumours in which the best formed nucleated cells are found, e. g. the epithelial tumours and some

* A good evidence of this is in the fact that the most original observers, when they speak of the development of the tissues, almost always cease for the time to be original, and copy both the words and drawings of Schwann or Valentin.

examp.es of medullary cancers, there are no higher forms found, not even imperfect fibro-cellular tissue, except in small quantity about the blood-vessels. Corpuscles having the characters of nuclei or cytoblasts (to adopt still the usual names) appear to be the really energetic bodies in the growth and determination of these morbid structures; they are found in some tumours so abundantly, and so unmixed with nucleated cells, that their power of multiplying and assimilating cannot be doubted; and it is in some of these tumours also that, apparently under the influence of the cytoblasts, the most perfect fibro-cellular tissue is ultimately formed. What I have seen also of the development of these cytoblasts, leads me to agree with that view of the development of nuclei generally, according to which they are described as formed, not on a pre-existent nucleolus, but out of granules collected in a dark or dim mass of the proper size and shape, which then clears up by the formation of a membranous wall and transparent fluid contents with, in some cases, one or more persistent granules holding the position of nucleoli.

Anatomy of Nucleated Cells. Although, if the doubts just expressed are well founded, we may have lost the thread for weaving the facts concerning cells into a system, still they must be collected with peculiar interest; for they must at some time be the basis of structural physiology.

In the last Report, several observations were mentioned concerning the molecular movements of particles within cells. Additions have been made during the year to the most interesting of these, namely those, such as Dr. Sharpey first observed, in which the movements are regular and in currents analogous to the currents of particles in the chara and other vegetables.

Professor Czermak* has described peculiar rotatory movements of particles in certain vesicles attached to the fine extremities of the seminal tubes of the black salamander. The vesicles are either attached to the peritoneal folds connecting the seminal tubes, or are imbedded in the tubes themselves; and the rotatory movements begin as soon as water is brought into contact with them. The vesicles are spherical or oval, from one fiftieth to one seventieth of an inch in diameter, and are covered by an outer layer of polygonal, mutually-flattened, granular cells. They contain, 1, round, oval, or pear-shaped corpuscles, some of which are not unlike blood-corpuscles, and which vary much in size, but have an average diameter of 1-2000th of an inch. 2. In many of the larger vesicles there is one large corpuscle, not granular, and occupying from one tenth to two thirds of the cavity, the rest of which contains corpuscles like those last described, or crystals. 3. The largest vesicles contain crystals of uncertain nature, alone or with the corpuscles before mentioned.

The rotatory movements vary according to the contents of the cells. The smaller corpuscles (of the first kind) move as if ciliæ within the vesicles impelled them. In some they move from side to side; in others, round their axes; in some, up and down; in some oval vesicles they move along the middle, from one end to the other, backwards and forwards. The movements usually continue for several hours, are accelerated by warmth, and are stopped by drying, or by completely soaking the vesicles in water. The vesicles which contain the larger (second kind of) corpuscles, show a different movement of their contents No ciliæ could be discerned on the large corpuscles, yet the small ones move along their margins just as if ciliæ seated there impelled them; and the large corpuscles themselves move slowly round their own axes in one constant direction.

The nature and mode of generation of the vesicles is quite uncertain; they at first were taken for the ova of entozoa, but the author gives reasons for thinking that they are not, and holds them to be analogous to those which Remak† found in the mesogastrium of frogs and has described under the name of ciliary vesicles.

* Oesterr. Medic. Jahrbucher, Jan. 1845.　　　　　† Müller's Archiv, 1841, II. v.

Kolliker* also has observed movements analogous to these within cells in two lower animals, namely, in the cells of the seminal filaments of *Polyclinum stellatum*, and in large cells in the sprouting arms of a young medusa-like radiate animal.

Centres of Nutrition. Mr. Goodsir† believes that the theory which he holds‡ of the existence of " germinal spots" in the secreting glands, i. e. of " a number of points from which acini are developed as from so many centres," may be extended to the process of development and nutrition of all the organs and textures. In an obscure exposition of his theory, he calls the points whose office corresponds to that of the germinal spots in glands, the " centres of nutrition," of the several textures. Each of these centres he considers to be " a cell, the nucleus of which is the permanent source of successive broods of young cells which from time to time fill the cavity of their parent, and then carrying with them the cell-wall of the parent, pass off in certain directions and under various forms, according to the texture or organ of which the parent forms a part." He names that a " germinal membrane," in which " the nutritive or germinal centres are arranged at equal or variable distances, and in certain directions in the substance of a fine transparent membrane." Such a membrane, identical with that which Mr. Bowman has named the basement-membrane, forms the tubules of glands, and the secreting epithelium is situated on its inner surface ; its nuclei are the germinal spots, or centres of nutrition. "A germinal membrane is occasionally found to break up into portions of equal size, each of which contains one of the germinal centres ;" showing that it "consists of cells with their cavities flattened, so that their walls cohering at their edges form the membrane, and their nuclei remain in its substance as the germinal centres." The secondary cells developed from the germinal spots or nutritive centres of such a membrane are always attached on its free surface ; they are at first contained between the two layers of the membrane, (these two layers being formed by the opposite walls of its component cells,) and when fully developed they carry forward the superficial layer, leaving the nuclei or germinal centres in the substance of the posterior or deeper layer in contact with the blood-vessels.

The theory is illustrated by the example of serous membranes.§ Their germinal membrane is the layer immediately below the epithelium. It does not, in general, show the lines of junction of its component flattened cells. These, its cells, appear to be elongated in the form of ribands ; their nuclei, or the germinal spots, being also elongated, expanded at one end, elongated at the other, somewhat bent, and directed, in general, parallel to the subjacent blood-vessels, in the neighbourhood of which they are most numerous. These flattened riband-shaped scales or cells, and the bright crystalline nuclei, appear identical with Henle's nucleus-fibres. (In aged and inflamed serous membranes, they appear to break up into areolar tissue). It is assumed that the nuclei are the sources of all the [epithelium] scales of the superficial layer of the serous membrane, each being the source of those in a certain compartment of its own ; and that, in the development of these epithelium-scales, the necessary nutritive material passes from the blood in the adjacent capillaries to the several centres, from each of which the scales of a compartment derive their origin and their nourishment, till they are detached.

Again, another example is referred to in the bones ; ‖ in which, as already stated, the mass of soft cells in each bone-corpuscle is considered to be the nutritive centre or germinal spot for all the cells within the range of the canaliculi of that corpuscle.

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* Entwick. der Cephalopoden, p. 156 ; in Reichert's Jahresbericht, u. s. p. 171 ; and in Schleiden u. Nägeli's Zeitschr. u. s, p. 101.

† Anatomical and Pathological Researches ; Edinb. 1845, p. 1.

‡ L. c. p. 29, and Trans. Roy. Soc. of Edinburgh, 1842. § L. c. p. 41. ‖ L. c. p. 65.

Development of Tissues. Mr. Owen * thus describes the development of dentine. The cells at the base of the dentine-pulp fall into linear series, directed towards the periphery of the pulp; while those at and close by the periphery, being already similarly arranged in series, become more closely aggregated and enlarged, and change as follows. The large granular nucleus of each increases, becomes more opaque around a pellucid point in its centre, and then divides through its long axis. The division is succeeded by a further transverse subdivision of each nucleus; and the subdivisions of each become elongated, with their long axes vertical to the plane of the pulp, and then attach themselves to the corresponding elongated and subdivided nuclei of cells in advance. The attached extremities of the nuclei become confluent, and form a linear, or rather, a wavy, series of granular matter.

While these changes are going on, the calcareous salts begin to be deposited—1st, they accumulate within the cells; 2d, they are aggregated in a semitransparent state round the confluent elongated granular nuclei, which now appear as secondary cells; and 3d, they occupy, in a still clearer and more compact state, the interspaces of the cells. The nuclear tracts, i. e. the series of granular nuclei, receiving a smaller proportion of the salts than the other parts do, constitute the areæ of the dentinal tubes; the nucleolar membranes, or secondary cells, become the proper walls of the dentinal tubes; the indications of the proper walls of the parent-cells are retained through a modification of the arrangement of the calcareous salts in and between them; and the salts deposited within the parent-cells and around the secondary cells convert the intermediate spaces into the intertubular substance. The primary curves of the dentinal tubes depend on the primary linear series of the parent-cells; the secondary curves are determined by the angles at which the subdivided and elongated nuclei unite when their extremities coalesce in the wavy series already mentioned. As the calcification proceeds in its centripetal course, the pulp decreasing in size, fewer nuclei are developed in the cells, and these are smaller. Thus it happens that the linear tract formed by the nuclear matter in a smaller cell unites with the converging extremities of two tracts of a cell in advance. Thus the bifurcation of a tube is produced; and the repetition of this, which becomes more frequent as the calcifying process approaches the base of the pulp, gives rise to the dichotomous division of the main tubes.

The tissues which Mr. Owen has named osteo-dentine and vaso-dentine, acquire their peculiar structure from the change which take place in the central smaller cells of the pulp being different from those just described. In the formation of osteo-dentine the cell retains its nucleus undivided, and the salts are imparted around it within the cell, but enter only partially into its granular substance. And in the formation of vaso-dentine many of the cells lose their nuclei, which appear to be dissolved. In both these substances the blood-vessels of the pulp remain; in true dentine they wholly disappear.

Mr. Owen's account of the development of enamel agrees with that generally received. He suggests that the transverse striæ of the human enamel-fibre may be caused by the remains of multiplied nucleoli subdividing or modifying the walls of the elongated enamel-cells.

In the development of the cement, the blastema of the capsule acquires a fine granular structure, in which the calcareous salts are imparted in a comparatively clear state, constituting the framework of the cemental tissue. They penetrate the cavities of the nucleated cells, which are arranged in concentric rows around the part already calcified and which rest in cup-shaped cavities in its periphery; but their progress is arrested by the large granular nuclei, which maintains an irregular area, partly occupied by the salts in a subgranular

* Odontography, p. xliii-lxi. The account given by Mr. Tomes, in his excellent Lectures on Dental Physiology, now in course of publication in the ' Medical Gazette,' is in all its principal parts nearly similar to Mr. Owen's.

opaque condition. From these nuclear cavities are subsequently developed the minute radiated tubes (calcigerous canals). But these cavities are not formed in the layer of cement which covers the crown of the human and some other simple teeth; the layer of capsule in which it is developed contains no nucleated cells.

Growth of Parts. A series of micrometric observations has been made by Professor Harting,* with the view, chiefly, of determining the changes of number and dimension which the elements of each tissue and organ undergo in their development and growth from the early period of foetal life to adult age. His results show that the elements of the tissues may be thus placed in two classes: 1st, those elementary structures which, from their first existence to adult life, increase in size either very little or not at all; so that the growth of the tissue which they form must be ascribed to their multiplication, not their enlargement; and 2d, those which constantly increase in size, till the tissue or organ which they form has gained its full dimensions, while their number does not increase after birth; the growth of the whole organ depending on their enlargement, not on their multiplication. In the first class he places the cells of epithelia, the fibrils of fibro-cellular tissue and tendons, the primitive fibrils of voluntary muscles, the cellular cavities of bones, and the blood-corpuscles. In the second class are the cells of the black choroidal pigment, of the fat, and of the liver, the primitive fasciculi (fibres) of voluntary muscles, and the fibres of involuntary muscle, the primitive nerve-tubules, the cells of cartilage, the urine-tubes and Malpighian capsules; and, probably, the fibres of elastic tissue and the ganglion-corpuscles. In a third class he says we might place a few elementary structures the number of which appears even to decrease after birth, e. g. the primitive fibres of muscles and the cells of permanent cartilage.

STRUCTURE AND FUNCTIONS OF THE URINARY ORGANS.

The *Structure of the Kidney* has been studied by Drs. Gerlach,† Bidder,‡ and Kölliker,§ who all confirm the description of Mr. Bowman in nearly every particular—only they all find that the Malpighian body or tuft of vessels does not lie naked or bare within the capsule. The first two describe it as covered by a layer of epithelium, reflected on it from the walls of the capsule, like the reflected or visceral layer of a serous membrane; and they admit a space existing between this reflected layer of epithelium and that by which the capsule is lined. Kölliker thinks there is no such space, but that the Malpighian body is imbedded in one continuous layer of epithelium, which on the one side covers and fits into all the spaces between its vessels, and on the other is attached to the structureless membrane which forms the wall of the capsule.

Gerlach also says that the Malpighian capsules (which he has examined in the injected kidneys of sheep) are not at the ends of the tubules, but are attached like diverticula to their sides—[but they are certainly terminal in the human kidney; and Bidder and Kölliker assert that they are so in the kidneys of the frog and the triton: they may be lateral in the sheep; but it is more probable that they only appear so when two tubules lead to one capsule. Whenever this happens, as it does sometimes in other than sheep's kidneys, the capsule which is really at the junction of the ends of two tubes may appear like a lateral diverticulum on one]. Gerlach, moreover, holds (as Valentin does) that the ciliary epithelium in the frog's kidney extends over the whole internal surface of the capsule; but neither Kölliker nor Bidder agrees to this.

Kölliker's observations were made in connexion with others on the primordial kidneys or Wolffian bodies, the structure of which he has found to be

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* Recherches micrométriques, 4to; Utrecht, 1845.   † Müller's Archiv, Heft iv, p. 378.
‡ Ibid. Heft v, p. 508.   § Ibid. Heft v, p. 518.

almost identical with that of the kidneys. They consist of tortuous tubules, which are formed by structureless membrane, lined by three or more layers of laminated epithelium-cells, the innermost layer of which bears long ciliæ. The ends of these tubules are dilated into Malpighian capsules, which are lined by a more delicate epithelium without ciliæ, and in each of which there is a Malpighian body, a tuft of capillary vessels, entering and leaving at the part opposite the connexion of the capsule with the tubule, and covered by a layer of cells.*

Excretion of Urine. In a boy affected with extroversion of the bladder, Mr. Erichsen† has observed the mode in which the urine flows through the ureters, and the rapidity with which substances pass from the stomach through the blood into the urine. His observations on the mode of excretion agree with others already made. When a drop of urine has collected within the termination of the ureter, which is elevated on a small papilla, the orifice of the canal opens to a diameter of two or three lines, and then, when the drop has passed it, contracts with a sphincter-like action. When the patient has neither eaten nor drunk for twelve hours, about three drops of urine pass every minute through each ureter, but at no regular intervals; neither is the action of the two ureters simultaneous, or regularly alternate. When the patient lies down, the urine does not flow at all for some time, and then flows slowly and gently, with a less distinct opening and shutting of the orifice of the ureter. Then, if he stands erect, after having been some time recumbent, it flows in a full stream till the ureters have emptied themselves of what had collected in them. During deep inspiration or straining, the flow of urine is suddenly increased, and it escapes in a small stream or in several rapidly succeeding large drops. Its excretion is made twice as rapid by violent exercise as it is during rest, and is peculiarly influenced during digestion. For fifteen or twenty minutes after a meal its flow is much diminished; at the end of this period it begins with increased rapidity, and so continues till the digestive process is nearly completed; and this increase occurred (though to a less extent) when no drink was taken with the meal.

The periods which elapsed between the taking of various substances into the stomach and their detection in the urine were various. Soluble saline substances passed, *cæteris paribus,* more rapidly than vegetable substances. The earliest period at which prussiate of potass was detected was about one minute after it was swallowed; the longest time that elapsed before it was found was thirty-nine minutes; and the chief source of this diversity appeared to be in the state of the stomach at the time. If the digestion of the last meal were finished, and the stomach empty when the solution of the salt was drunk, its passage to the urine was effected in one or two minutes; if the stomach were still digesting, its passage was retarded. The time required for the passage of vegetable infusions was from sixteen to thirty-five minutes; it also varied, but in a less degree, according to the condition of the stomach.

Some other experiments were made to ascertain how soon after taking alkali-salts the urine would become alkaline. Solutions of the citrates and tartrates of potass and soda were given; and the time required for their decomposition and the appearance of their bases making the urine alkaline varied from twenty-eight to forty-seven minutes. In one case, after taking two drachms of bicarbonate of soda saturated with lemon juice, the urine did not till the sixth day recover its natural acid reaction. Its quantity was rapidly and greatly increased by taking the salts of soda.

* In a paper published in the Medical Times, April 4, 1846, from a Vienna Journal for March, Professor Hyrtl, maintains that the Malpighian capsules have no connexion at all with the urinary tubules, but open into the lymphatics. His account is said to have been drawn from most industrious, careful, and varied researches; but it is contradicted by observations which have been so often repeated and appear so secure from the danger of error, that I must for the present believe him to be thoroughly mistaken.   † Medical Gazette, June 27, and July 4, 1845.

[The publications on the chemical properties of the urine have been, in the last year, so numerous, that nothing less than a special report on them would give a sufficient account of their contents. I shall therefore only give the titles of the chief of them, and a brief notice of the nature of the contents of those which I have read. Many of them treat of things which are at present so far from being applicable in human physiology that the omission of a longer notice of them will not be regretted.]

E. v. Bibra. Ueber den Harn einiger Pflanzenfresser; in the Annalen der Chemie und Pharmacie, Januar, 1845; containing analyses of the urine of the horse, pig, ox, goat, and hare.

Golding Bird. On the mode of ascertaining the proportion of solid matters in the urine; in the Medical Gazette, May 23, 1845; giving a very useful table for ascertaining this at sight; a short rule being that if the sp. gr. of a sample of urine be expressed in four figures, (water being 1000,) the last two figures will nearly express the number of grains of solid matter in a fluid ounce of the urine; the quantity thus estimated being always rather less than the true quantity.

Boussingault. Recherches sur l'urine des animaux herbivores; in the Annales de Chimie et de Physique, Sept. 1845; analyses of the urine of the pig, horse, and cow, and an account of the relation which it bears to the food of each.

Chambert. Sur les sels et la densité des urines chez l'homme sain; in the Recueil des Mém. de Médecine militaire, t. lviii, and in the Annuaire de Chimie, 1846, p. 693. Data, but no definite conclusion, for estimating the relation between the sp. gr. of urine and its saline and organic contents; with new modes for certain parts of the analysis.

Heintz. Ueber die harnsauren Sedimente; in Müller's Archiv, 1845, p. 230; an explanation of the formation of the amorphous precipitates of urate of ammonia in cooling urine. The same chemist has published an essay on the mode of determining the proportions of urea, potash, and ammonia in urine, in the Annalen der Physik und Chemie, t. lvi, p. 114.

Bence Jones. On the variations in the alkaline and earthy phosphates in the healthy state, and on the alkalescence of the urine from fixed alkali; in the proceedings of the Royal Society, Jan. 19, 1845, and in the Philosophical Transactions, Part I, for 1845; showing the increase of the earthy phosphates after taking food, and their decrease after long fasting; also the increase of alkaline phosphates after feeding on bread alone, and after exercise; with other similar facts.

Laveran and Millon. Sur l'élimination de l'antimoine par les urines; in the Comptes Rendus, p. 237, t. xxi, and in the Annuaire de Chimie, 1846, p. 715; showing the intermittent and very slow elimination of the metal through the kidneys.

Marchand. On the composition of the urine of a tortoise; in the Journ. für prakt. Chemie, t. xxxiv, p. 244.

Möller. Ueber das Kystein; in Casper's Wochenschrift, Januar. 11, 18, 1845; a summary of his own and other's observations to show the little value of the presence of this principle in urine as a sign of pregnancy.

Pettenkofer. Ueber das Vorkommen einer grossen Menge Hippursäure im Menschenharne; in the Annalen der Chemie und Pharmacie, Oct. 1844. The urine of a girl thirteen years old, with chorea, contained 1·2886 per cent. of hippuric acid: a quantity equal to one fourth of all its solid constituents.

Pettenkofer. Ueber einen neuen stickstoffhaltigen Körper im Harne; in the Journal last quoted, p. 97.

Rabsky. A new mode of determining the proportion of urea; in the Annuaire de Chimie, 1846, p. 699.

Krukenberg. On the uniform influence of sweet fruit in making the urine

alkaline, and the production of alkaline urine by the morbid secretions of the bladder after injuries of the spine; in the Oesterr. Medicin. Wochenschrift, 11 Januar. 1845, from Henle u. Pfeuffer's Zeitschrift, Bd. iii. [On all that relates to the progress of animal chemistry, or of chemistry in any other department, the reader may best consult the admirable Annuaire de Chimie of MM. Millon and Reiset. The Reports, also, by Dr. Day, in the 'Lancet' of February 1845, and in Dr. Ranking's Half-yearly Abstract, contain the substance of many of the best papers on animal chemistry.

ORGANS AND FUNCTIONS OF ANIMAL LIFE.

Structure of Joints. Mr. Goodsir * points out the highly vascular fringes and processes of synovial membrane as more active in the formation of epithelium, and therefore more closely allied to the secreting organs, than other portions of these membranes are. The pulpy nature of their serous covering, their vascularity, and their position where they do not interfere with motion, but hang into the parts of the cavities which may be reservoirs of synovia,—all, he thinks, favour this opinion.

Anatomy of the Knee-joint. Dr. Gruber † has dissected 160 knee-joints to determine how, and how often, the bursæ near the joint communicate with it, and what are the usual arrangements of the recesses formed by the synovial membrane. The chief things he has noticed are—1. The sac which the membrane forms between the outer and posterior part of the joint and the tendon of the popliteus, and which covers the outer margin of the external semilunar cartilage, is often divided by a septum into two parts, placed one behind the other, and communicating by one opening with the joint. 2. The bursa under the quadriceps femoris is found in about every sixth or seventh person; and communicates with the cavity of the joint in about every ninth person. In 47 males it had a separate cavity in only 9; and in 33 females in only 3. 3d. The bursa between the tendon of the M. semimembranosus, the inner condyle, and the inner head of the M. gastrocnemius, is often locular or divided by septa into two or three cavities. In robust persons it is often, though not diseased, two and a half inches long and three fourths of an inch broad, so that it may be felt externally, and in them it generally communicates with the joint by an opening half an inch in diameter. 4. The bursa under the lig. patellæ was once found communicating with the joint; that under the inner head of the gastrocnemius never was: a communication between the femoro-tibial and tibio-fibular articular cavities was very rarely seen.

Muscles of the Larynx. Dr. Gruber ‡ has also found (but only once in a hundred dissections) a muscle which he names the M. thyroideus transversus anomalus. It is placed transversely over the upper two thirds of the middle crico-thyroid ligament, between the angle of the thyroid cartilage and the crico-thyroid muscles. Its greatest breadth is four and a half lines; its greatest width seven and a half. It has both its origin and insertion on the inferior angle and margins of the thyroid cartilage. The upper fibres are transverse and straight; the lower are longer and arched, with their convexities downwards. They are all fleshy at their attachments, and all have additional points of insertion on the crico-thyroid ligament. The action of the muscle is supposed to be assistant to the crico-thyroid muscles; to make the crico-thyroid ligament tense when the thyroid cartilage is fixed, and, when in full action, to approximate the alæ of the cartilage; or, when the cricoid cartilage is fixed it may draw the thyroid downwards and forwards.

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* Anatomical and Pathological Observations, p. 42.

† Prager Vierteljahrschrift, 1845, B. i; and Oesterr. Med. Wochenschr., 25 Jänner, 1845.

‡ Oesterreich. Medic. Jahrbucher, Mai, 1845.

NERVOUS SYSTEM.

General Structure, Origin, and Course of the Nerve-fibres. The most important contribution to the physiology of the nervous system, perhaps, indeed, the most important physiological production of the year, is from Kölliker.* The main design of his essay is to discuss the question of the independence and speciality of the sympathetic nerve. This, it is known, has been long disputed; especially between Bidder and Volkmann on the one hand, and Valentin on the other. The former maintained, as the anatomical evidence of the independence of the sympathetic, that there belonged to it a peculiar set of nerve-fibres, characterised by their fineness, (they being only about half or one third as large as the cerebro-spinal fibres), their paleness, the absence of a double contour, their nearly uniform contents, and their yellowish gray colour when in bundles. The latter held that the sympathetic fibres are neither in structure nor in relations peculiar. The several statements on both sides have been nearly all inserted in former Reports.†

In the discussion of the question, Kölliker decides—1st. That the fibres described by Remak as peculiar to the sympathetic nerves, and which are commonly called Remak-fibres, are, as Valentin has always held, not nerve-fibres at all, but neurilemma, consisting of imperfectly developed fibro-cellular bundles. 2d. He determines that Bidder and Volkmann are right in their description of the structure of the fine nerve-fibres, or, at least, of the well-marked examples of them; and that these are not (as Valentin maintained that they were) Remak-fibres. But he denies that these fine nerve-fibres are peculiar to the sympathetic system, or even so different from the common larger cerebro-spinal nerve-fibres that they ought to be regarded as of a kind distinct from them. To justify this denial he shows that the characters assigned to these fine nerve-fibres as distinctive, by Bidder and Volkmann, are neither definitely marked, nor constant, nor essential; that there is no real difference between these fine fibres and those of the brain, spinal cord, and nerves of special sense; that, commonly, the large fibres assume near their peripheral ends the size and some other characters of the smaller ones; and that many fine fibres are found in all nerves, though it is generally true that there is a smaller proportion of them in the cerebro-spinal than in the sympathetic nerves.

But, although it thus appears to be an error to speak of sympathetic and of cerebro-spinal nerve-fibres as if they were two different *kinds* of fibres, yet the differences which do exist between them, and the various proportions in which the fine fibres occur in different nerves, make it important to discern their origin and course. On these points, Kölliker first proves the most important fact that these fine fibres have their origin not only in the ganglionic or nerve-corpuscles of the sympathetic ganglia, but in those also of the ganglia on the cerebral and spinal nerves, and in the corpuscles of the brain and spinal cord. In this, his observations fully confirm those of Helmholtz, Will,‡ and Hannover,§ who like him have seen this mode of origin, and of Bidder and Volkmann, who from another mode of investigation concluded that fine fibres must thus arise. Kölliker has seen this mode of origin of nerve-fibres in the spinal cord and in the spinal and sympathetic ganglia of the frog, in the spinal ganglia of the tortoise and cat, and in the Casserian ganglion of the cat and guinea-pig. Hannover has found it in all classes of vertebrata and in many invertebrata, in the brain and spinal cord, and in ganglia of all kinds; neither has he observed any other mode of origin besides this. The description given

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* Die Selbständigkeit und Abhängigkeit des sympathischen Nervensystems; Zurich, 1844, 4to.

† Report on Microscopic Anatomy, pp. 33-5; Report for 1842-3, p. 18; Report for 1843-4, pp. 43-4-8. All that Bidder and Volkmann have maintained may also be found in the art. Nervenphysiologie, by the latter, in Wagner's Handwörterbuch   ‡ See last Report, p. 45.

§ Recherches Microsc. sur le Système Nerveux; Copenhague, 1844, 4to.

by Kölliker of the spinal ganglia of the frog is, that they contain one form of ganglion-, or nerve-corpuscles, which are of simple shape and give off no processes; and many other corpuscles, more or less pyriform, which at their smaller ends are drawn out into a process. This process, like the corpuscles, is pale and finely granular; it is from 1-10,000th to 1-7000th of an inch in diameter, and after proceeding about 1-1000th of an inch, it rather suddenly acquires a dark contour and slightly granular contents; it, in short, becomes a fine nerve-fibre. And, in regard to those cases in which he has not *seen* this mode of origin of the fine fibres, Kölliker so far confirms or admits the truth of Bidder and Volkmann's observations respecting the relative number of fine fibres which enter and leave the ganglia, that he considers it proved that a great number of these fibres have their origin in the ophthalmic ganglion, and in the ganglion of the vagus of fish; and considers it as highly probable that the ganglia of the cerebral and spinal nerves of all the higher animals are also sources of origin for similar fibres.*

To these observations may probably be added those of Dr. Todd and Mr. Bowman.† For although they do not demonstrate it, yet it is, as they state, most probable that one (or more?) of the processes of those which they name "caudate nerve-vesicles" is prolonged into a nerve-fibre. Their description of these vesicles or corpuscles is that they possess the general characters of the common nerve-vesicles, but have one or more long processes from their central parts or bodies. These processes, like the interior of the vesicle, are very delicate, frail, and finely granular. When unbroken, one or more of them may be traced, extending far from the vesicle, then dividing into two or three branches, which again divide, and give off extremely fine transparent fibres, such as may either connect distant nerve-vesicles, or become continuous with nerve-fibres. Such vesicles, they say, are best found in the locus niger, and in the gray matter of the cerebellum and spinal cord; and the tissue in their vicinity is freely traversed by delicate filaments which appear to be the ramifications of their caudate processes.

It has been already said that these fine fibres proceeding from the nerve-corpuscles are not peculiar to the sympathetic nerves (commonly so-called); yet all the branches of these sympathetic nerves contain a larger proportion of them than the common cerebro-spinal nerves do, and some of them contain no other fibres besides these. And assuming that the origin of these fibres is proved, the next question concerns their mode of distribution. Kölliker shows that there are much greater difficulties in the way of tracing these fine fibres from their origins than Bidder and Volkmann supposed. All that can be certainly said is that, 1st, the fibres arising in the sympathetic ganglia go partly to the viscera, and partly through their communicating branches, (which have been often called origins, or roots of the sympathetic, and are composed almost entirely of fine fibres,) to the anterior branches of the spinal nerves, in which most or all of them pass peripherally; 2d, some of the fine fibres which arise in the spinal ganglia pass through the communicating branches to the sympathetic, and are distributed in the viscera, and others go to the posterior branches of the spinal nerves; 3d, the fine fibres arising in the ganglia of cerebral nerves probably pass out from them with the nerves that are proceeding to their peripheral distribution. But it is yet uncertain whether the sympathetic ganglia‡ send fibres into the posterior branches of the spinal

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* The most striking instance in which more fibres leave than enter the ganglia is seen in the septum of the auricles of frogs' hearts, which is so transparent that the ganglia and nerve-fibres may be counted in it. Here Bidder has often seen more fibres in one than in the other of the two branch from a ganglion—e. g. five in one, and seven in the other. Volkmann, in Art. Nervenphysiologie, l. c.

† Physiolog. Anatomy, p. 314, fig. 55-6.

‡ i. e. the ganglia of the sympathetic system commonly so called; the sympathetic system of Volkmann includes *all* the fine nerve-fibres, wherever they originate.

nerves; whether the spinal ganglia send fine fibres to their own anterior branches; whether the fine fibres arising in the spinal cord go to the sympathetic or to the spinal nerves, or to both; and what course the fine fibres which run with the spinal nerves take, though, from the large number of them in the branches of sensitive nerves, one may conclude that they are chiefly distributed with these.

As to the relative proportions of large and fine fibres in the nerves distributed to various parts, Kölliker concludes from his own and other observations that, 1st, the nerves of voluntary muscles contain in their trunks a majority of large fibres, but in their peripheral distribution either only, or a majority of, fine fibres; 2d, the nerves of the skin contain (for the most part) equal numbers of both; but in some of them, one or other size of fibres greatly preponderates, and in all of them the fine fibres greatly preponderate in their peripheral distribution; 3d, the nerves of sensitive mucous membrane are, in this respect, like those of the skin, except that in the nerves of the teeth-pulps and the gums there is a great majority of large fibres; 4th, in the nerves of involuntary muscles, and of the less sensitive or insensible mucous membranes, there is a great predominance of fine fibres.

To these important conclusions respecting the general anatomy of the nerve-fibres, a few less considerable facts may still be added.

Structure of the Fibres. Stadelmann* describes the axis-cylinder of the nerve-fibres as very distinctly visible in transverse sections of them. Its outline has commonly the same form, and is nearly half as large, as that of the nerve-fibre itself, but sometimes it looks like a mere chink or a central point.

Harting† has once noticed (but long after death) some peculiar fibres in the neurilemma of a nerve on the abdominal muscles of a Molge (Triton?) punctata. They were narrow, spirally twisted, band-like, with sharp outlines, and each of them had on its outer edge a row of very short ciliæ, which ended in minute round knobs, and were set at regular distances from one another. The average width of the fibres was about 1-1600th of an inch; the average length of the ciliæ 1-1100th; the diameter of their knobs 1-2300th; their distance apart about 1-800th.

Central Terminations of Nerve-fibres. Probably we must not conclude from the foregoing observations by Hannover, Kölliker, and others, that the fibres in the nerve-centres have no other mode of termination (if it may be so called) than that by connexion with the nerve-corpuscles. In the last Report, I mentioned the observations of Dr. Lonsdale,‡ who found, in two cases of anenaphalous monsters, that the nerve-fibres in the truncated portions of the fifth and other nerves, which hung unattached in the base of the skull, formed loops; a fact which seemed confirmatory of the theory of central terminal loops of the nerve-fibres in the brain. I have recently had occasion to confirm this fact in a mature fœtus, whose cerebro-spinal axis was truncated at the medulla oblongata. In the loose hanging ends of the fourth and fifth nerves, all the fibres appeared forming loops, exactly like those figured by Dr. Lonsdale. There can be no doubt therefore that this is the usual arrangement of the nerve-fibres in these cases, whatever may be the import of the fact.

Peripheral Terminations of Nerve-fibres. In doubt concerning the terminal loops of nerve-fibres, Volkmann§ tried the experiment of dividing half the

* Sectiones transversæ partium corporis humani, p. 17.

† Tijdschrift voor natuurl. Geschied. en Physiologie, 1845, d. xii, st. 1. In another examination he could not find these fibres. There is some similarity between this observation and that of Remak, in Müller's Archiv, 1841, p. 39, and Valentin's Repertorium for 1841, p. 108.

‡ In the Edinb. Med. and Surg. Journal, No. 157.

§ Wagner's Handworterbuch, art. Nervenphysiologie, p. 565.

trunk of the infra-orbital nerve, thinking that if there were terminal loops, at least several of the fibres divided might be connected at their peripheral parts with some of the undivided fibres ; and that thus, on irritating the peripheral portion of the divided nerve, the impression might be conveyed centrifugally through its fibres, then through the loops and through the undivided fibres to which they led, and thus to the brain. But no pain was produced by the irritation ; indicating either that sensitive nerves do not convey impressions towards the periphery, or else that there are no such peripheral loops as can convey impressions from one nerve-fibre to another.

Termination of Nerve-fibres in the Pacinian Corpuscles. The discoverer of the Pacinian corpuscles has continued his observations* on these bodies, and confirms the account of Henle and Kölliker recorded in the last Report. The nerve-filament within the corpuscle has, he says, a single contour, like the sympathetic filaments ; up to the base of the corpuscle its contour is double. At its termination it presents a granular swelling like the common ganglion-corpuscle.

Anatomy and Physiology of the Nervous Centres in general. The researches of Hannover and Kölliker already reported, confirming and much extending those recorded in the last Report, render it necessary to admit the existence of many more nervous centres than are commonly reckoned. If under this title we may include all those bodies in which nerve-fibres have their origin or termination, and of which it can be made probable that they are centres or co-ordinators of the actions of many nerves, we must now include not only the brain and spinal cord, but, probably, all the ganglia on the spinal and cerebral nerves, and all those of the sympathetic system ; for in all these we may believe, on the grounds already adduced, that there are nerve-corpuscles giving origin to nerves; and in many (as will presently appear), there is evidence of the same kind of action as in the acknowledged nervous centres. Not indeed that all these nervous centres have the same powers—they are not, like the brain, in direct communication with the mind, nor have all so wide a range of action as the cord ; but each is a nervous centre to its own district, receiving from, and sending to, its own parts, the impressions which pass along the nerve-fibres which enter it. Each also is in communication with other centres, and, probably, through one or more of these, with the spinal cord ; through which also, if not more directly, all may be connected with the brain, the head of the whole nervous system, through and beyond which no impression can be conveyed.

Centres of the System of the Sympathetic Nerves. The same researches of Kölliker and others show that this nerve, or system, may now be described as mainly composed, 1st, of ganglia, which (like other ganglia) contain (*a*) nerve-fibres traversing them ; (*b*) nerve-fibres originating in them ; (*c*) nerve-corpuscles giving origin to nerve-fibres; and (*d*) free nerve-corpuscles ; and, 2dly, of various nerve-fibres, comprising (*a*) those which arise in their own ganglia ; (*b*) those which it receives from the ganglia of the spinal and cerebral nerves ; and (*c*) those which it receives from the brain or spinal cord, or both. Among the last are, probably, the large fibres, which are contained in some of the branches of the sympathetic, and through which the occasional influence of the brain and spinal cord upon the viscera is probably exercised.

Now all these same elementary structures occur in different proportions in the cerebro-spinal nervous system, and some of them pass from it into the sympathetic. Kölliker's conclusion is, therefore, that the sympathetic nerve is independent and peculiar, not by peculiar elements which are not found in

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* Annali Univ. di Medicina; Luglio, 1845, p. 208.

other parts of the nervous system, but by its very numerous ganglia, by the fine fibres which proceed from their corpuscles, and by the general complexity of its composition; and that it is dependent on the other parts of the nervous system, in that it receives fine fibres from the ganglia of the cerebral and spinal nerves, and both fine and large fibres from the brain and spinal cord. Probably, however, it is in this respect more dependent in the higher than in the lower vertebrata.

And, as for the function of the sympathetic, these facts prove that its ganglia are so many centres of origin for some of its fibres; and they thus afford the anatomical evidence of what analogy and the physiology of the system had already rendered nearly certain, namely, that each ganglion of the sympathetic is, in its own sphere, a nervous centre, receiving, transmitting, reflecting, and, perhaps, even originating, the impressions on which the harmonious movements of the parts to which its nerves are sent depend. It is not necessary here to enumerate the organs thus dependent on nervous centres of the sympathetic, or the degrees in which they are severally subject to the influence of the brain and spinal cord. The best examples of movements governed by the sympathetic are afforded by the actions of portions of the heart, mentioned in a former part of this Report; by the many days' continuance of all the organic functions in frogs, after the removal of the brain and cord (saving the medulla oblongata);* and by the wide-extended influence of irritation of the intestines, if they are cut out with the mesentery (in which are their ganglia) still attached.

The influence of the sympathetic on the nutrition of the parts to which it is distributed is commonly known; such an influence appears to me to be constantly in exercise, affecting not only the quantity, but the mode, of nutrition in parts. I am surprised that so acute a physiologist as Kölliker should think this influence is exercised only in the power which it may have of determining the size of the blood-vessels; as if the vessels were not enlarged in many conditions, the results of which are all different; but I repeat what was stated in the last Report, that there is at present no evidence that the sympathetic system (i. e. the system commonly so called) exercises an influence on nutrition different either in degree or in kind from that which is exercised by the cerebro-spinal system.

General Physiology of the Spinal Cord. The general tendency of the investigations of the last year has been to prove that the spinal cord is neither a mere collection of tracts of nerve-fibres nor a single nervous centre, but (if I may use the most popular language of the day) a collection or series of *central stations,* each of which has its own lines of nerve-fibres terminating in it, and serves to receive, and to transmit on numerous lines and in various directions, the impressions which are conveyed by the centripetal nerves abutting on it. The chief evidence for this, which, though not a new view, has hitherto been a very doubtful one, is as follows:

1. Volkmann† has submitted the question whether the nerve-fibres of the spinal nerves remain and end in the cord, or go on to the brain, to the test of a kind of measurement. He weighed four pieces of a horse's spinal cord, each seven centimeters long, and taken respectively from below the 2d, the 8th, the 19th, and the 30th pairs of nerves. Their weights (in the order above named) were 219, 293, 163, and 281 grains; the areas of the transverse sections of the gray matter in them (in the same order) were 13, 28, 11, and 25 square lines; and those of the white matter 109, 142, 89, and 121 square lines. Thus, the quantity of white matter of the cord is absolutely less at the cervical

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* See last Report, and Volkmann's Art. Nervenphysiologie, p. 500.
† Wagner's Handworterbuch der Physiologie, art. Nervenphysiologie.

than at the lowest part of the lumbar portion, and much less in the lower than in the upper cervical portion. The contrast was more marked in a comparison of the sum of the areas of transverse sections of all the spinal nerves of a serpent (Crotalus mutus) with that of a section of the upper part of the spinal cord. The former (purposely estimated below the truth) might be reckoned at ·0636 of a square inch; the latter only ·0058. The total size of the nerves, therefore, is at least eleven times greater than that of the cord—a difference which cannot be explained on the supposition that the nerve-fibres, when they pass into the cord, become smaller.

2. The almost necessary deduction from these facts is that many or all the nerve-fibres terminate in or very near those regions of the cord into which they penetrate; and this is strongly confirmed by the observations of Hannover and Kölliker, already often referred to, both of whom have demonstrated the fine nerve-fibres as prolongations of the processes of some of the nerve-corpuscles of the gray matter of the cord.

3. A step further is made by the remarkable observations of Volkmann, which have determined at least two examples of small portions of the cord having absolute and uninfluenced control over the movements of parts, to which parts they are the true and sole nervous centres. I refer here to the governance of the rhythmical movements of the lymphatic hearts by the two definite portions of the cord, of which an account has been already given. The evidence is complete that these portions of the cord are as truly the nervous centres for the two hearts as the portion of the medulla oblongata is for the respiratory movements.

4. Something of the same kind as this influence of the cord on the lymphatic hearts is indicated by an observation of Budge.* If a piece of the cord of a frog, scarcely two lines wide, be removed from the place at which the great brachial nerve goes off, it constantly occurs that the pulse of the heart decreases in frequency within two hours after the operation, and this does not happen when all the rest of the cord below this portion is removed.

But if it be thus proved that there are in the spinal cord many central stations, the question still remains, how an impression is conveyed from one to the other, or from any of them to the brain?† It is evident, that there are other modes of conveyance besides that through the continuous course of the fibres first impressed; it is not certain that any fibres pass uninterruptedly from the periphery to the brain, yet the impressions are precisely conveyed both to and from the brain; and there is no support in all these facts for the erroneous experiments of Van Deen,‡ which would have made it appear that not only the nerve-fibres, but the impressions also, stop short in or near the part of the cord on which they fall. Some of his more correct experiments show that even a small length of the gray matter left in the cord, when all around it is cut away, is sufficient for the conveyance of impressions up the cord of the frog, but how the conveyance is effected is as yet a question.

Some isolated facts concerning the anatomy and physiology of the spinal cord remain to be reported :—

Dr. Harless§ has described some singular results obtained by the action of a constant weak galvanic current on the spinal nervous system of frogs at the time of their greatest irritability, i. e. before the waking from hybernation. One pole was applied to the skin, the other to the spinal nerves of a beheaded frog. When the violent general convulsions had ceased, periodically inter-

* Oesterr. Medic. Wochenschr., 10 Jan. 1846 ; from Froriep's Notizen, 1845, No. 783.

† Hypotheses have been suggested in the year just passed by Drs. Todd and Volkmann (l. c.), but they both seem to me insufficient for the facts.

‡ See last Report, p. 50, and Report for 1842-3, p. 20.   § Müller's Archiv, 1845, Heft i.

mittent convulsions, with regular intervals of rest from three to six seconds long ensued, and these often went on for one or two minutes. After these had ceased, there were no more spontaneous twitchings; but if, while the body was at rest, the slightest shock were given to the dish or the table on which it lay, it produced severe tetanic convulsions of the whole frame, which lasted from seven to eight seconds. The same convulsions were produced in an amputated leg subjected to the same influences; they were therefore not dependent on a reflex influence, but were direct. Careful examination showed that the shock which produced the convulsions did not at all displace the poles of the battery, so as to break and then renew the circle, and thus give each time a fresh galvanic irritation. And it was found that a shock, though slight, if given even to the connecting wire alone of the battery, was sufficient to excite the same tetanic convulsions. It was thus and by later experiments evident, that a shock communicated to a voltaic apparatus is sufficient to produce an alteration in the intensity of current, increasing it enough to produce convulsions in the animal galvanometer, and a greater deviation of the multiplier-needle.

Cerebro-spinal Fluid. M. Longet[*] has found that the peculiar unsteady tottering movements, like those of drunkenness, which M. Magendie ascribed to the removal of the subarachnoid fluid of the spinal cord, are really due to the division of the muscles of the occipito-atlantal region, which is made to form a passage through which the fluid may be drawn off. Whenever M. Longet drew off the fluid without injuring these muscles, the animal preserved the power of motion unimpaired; but when he divided the posterior sub-occipital muscles, (including always the recti capitis postici minores, and the supra-spinous ligament in the animals in which it exists,) the peculiar defects of motion were produced, although the cerebro-spinal fluid was left untouched, and the sheath of the cord unopened. He ascribes the impairment of motion in these cases to the falling of the head when its attachments to the atlas are destroyed, and the consequent dragging and pressure of the upper part of the cord, and especially of the medulla oblongata and pons. For the effects of the division of the muscles and other tissues are completely prevented by artificially supporting the animal's head in a raised position; and in different animals, the degree in which the movements are impaired is directly proportionate to the amount of separation which takes place between the occiput and atlas, when their connexions (the occipito-atlantal ligament excepted) are divided. The speedy recovery of the animal, which Magendie ascribed to the rapid reproduction of the fluid, M. Longet considers to be due to the readiness with which the nervous masses (especially in animals) adapt themselves to new and unnatural pressure. He observed a striking analogy between the effects of the division of these muscles, and those observed by M. Flourens and himself in consequence of injuries of the cerebellum; and hence draws another evidence, that the former are due to the pressure and dragging of the medulla and pons, with which the crura of the cerebellum are connected.

Relation of the Nerve-roots to the Spinal Cord. Van Deen[†] has published a plate from an accidentally-obtained preparation magnified 320 diameters, which appeared to show the mode in which the filaments of the nerve-roots are arranged in the substance of the cord. The central filaments of the root are drawn passing straight into the cord; the upper and lower ones passing in oblique lines upwards and downwards respectively. They all appear variously interlacing with the filaments of the cord, which, for the most part, run longi-

[*] Bull. de l'Acad. de Médecine, 15 Sept. 1845, and Gazette Médicale, 6 Sept.; and in other contemporary journals. See also Comptes Rendus, 7 Juillet, 1845.
[†] Tijdschrift voor Natuurl. Geschied. en Physiol., 1844, st. 2.

tudinally; but he could in no instance find a continuity between the two. His account thus far agrees nearly with that of Stitting.

ANATOMY OF THE BRAIN. *Cerebro-spinal Membranes and Vessels.* Among the observations which Purkinje[*] has republished from his Essay, first printed in 1838, are many concerning the nerves of the membranes and vessels of both the brain and the spinal cord. In the cerebral dura mater, the nerves are most abundant in the neighbourhood of the trunks of the three chief meningeal arteries. They come to these from the sympathetic system,[†] and the principal part lie in company with the arteries; but some also leave them and ramify separately in the substance of the membrane.

In the dura mater inclosing the spinal cord, Purkinje could not find a trace of nerves; but on the fibrous lining of the vertebral canal and the sinuses between it and the bodies of the vertebræ, (which fibrous lining may be regarded as an outer layer of the dura mater, divided at the foramen magnum,) he found abundant plexuses of sympathetic fibres.

The pia mater of the cerebellum displays many nerves, which branch separately from the arteries as those of the pia mater of the cord do; but they are less abundant than those are. The nerves ramifying on the pons and on the cerebrum appear, on the contrary, to belong exclusively to the arteries. In the choroid plexuses no trace of nerves could be found; but there is a dense plexus of filaments of the sympathetic system around the vena magna Galeni. It passes into the tentorium cerebelli, and appears to belong to it more than to the venous system.

In the pia mater of the spinal cord, a much more copious distribution of nerves exists than in any part of the cerebral membranes. The largest fasciculi, containing from thirty to fifty filaments, are near the anterior spinal artery, whence some pass into the process of pia mater in the anterior fissure, and form loops therein. Other large bundles which, for the most part, run longitudinally, are near the ligamentum dentatum, and about the posterior median line of the cord, though here they are less abundant than in front. In the neighbourhood of the origins of the spinal nerves, the bundles of sympathetic filaments are fewer and smaller. Their number is greater about the upper than about the lower part of the cord.

All the nerve-filaments of these plexuses in the pia mater appear to belong to the sympathetic system. They combine with those already mentioned on the pons and cerebellum; but have never appeared to be connected with the roots of the cerebro-spinal nerves. Some of the filaments come to the pia mater with its arteries; but they soon part company, and the nerves appear to increase, and form plexuses quite independent of the arteries [‡]

Dimensions of the Brain. M. Baillarger[§] has invented a new mode of measuring the surfaces of brains, by dissecting out all the white substance from their interior, and then unfolding the exterior, and taking a cast of it. From his measurements he estimates that the average superficial extent of the human brain is 669·3 square inches; and that it is far from true that, in general, the intellect of different animals is in direct proportion to their respective extents of cerebral surface. If their absolute extents of surface be taken, the rule is manifestly untrue in many instances; and it is not more

[*] Müller's Archiv, 1845, Nos. iii, iv.

[†] He suggests also that those which dissectors have supposed to be branches of the fourth and fifth nerves, going to the dura mater, are really branches of the sympathetic, which pass through these nerves to the membrane.

[‡] As already stated, this account of the nerves of the membranes of the cord is confirmed and extended by the original observations of Mr. Rainey. It is also confirmed by Volkmann, in his article, Nervenphysiologie, already often referred to.

[§] Gazette Médicale, 19 Avril, 1845; Report from the Acad. de Médecine, 15 Avril.

true if the extent of surface in proportion to the volume of the brain be regarded; for, according to M. Baillarger's measurements, the human brain has less superficial extent in proportion to its volume than that of [many] inferior mammalia.

PHYSIOLOGY OF PARTICULAR CLASSES OF NERVES. *The Motor Nerves.* It has been already mentioned that E. H. Weber has successfully employed the continuous electric current developed by a rotating magnet for maintaining constant contraction of the voluntary muscles. He has also* applied it for testing the functions of the pneumogastric nerves; and it has been employed by Volkmann,† in an extensive series of experiments on the functions and modes of action of the motor nerves generally. The chief results are as follows:

1. The central organs, but not the nerves, are capable of an excitement which induces fixed muscular contraction even after the withdrawal of the external stimulus. For, with the magneto-electric stimulus applied directly to them or their nerves, the voluntary muscles, the œsophagus, separated fasciculi from the heart, and the iris (?) remain contracted just as long as the stimulus acts upon them, but no longer; but if the same stimulus be applied to the brain or spinal cord, the contraction of the voluntary muscles and œsophagus is prolonged after its withdrawal.

2. The motor nerves of the anterior, but not those of the posterior extremities [of the frog], arise from the uppermost part of the spinal cord. For if the anterior part of the cord be electrified, the contraction of the anterior extremities is often prolonged after the withdrawal of the stimulus; but that of the posterior extremities ceases with the cessation of the stimulus. Now, if the motor nerves of both extremities arose in the brain, this difference would be unaccountable; and as, according to the preceding rule, it is stimulus of the central organs alone which induces prolonged contractions, it follows that the upper part of the cord is a centre to the brachial, but not to the sciatic, plexus [of the frog].

3. The motor nerves of the heart, stomach, and intestines arise neither in the brain nor in the spinal cord; for none of these organs is thrown into fixed contraction when the brain and cord are directly stimulated by the magneto-electric current, although it is a law that all muscles will thus contract when either the origins or the trunks of their nerves are stimulated.

4. The heart has a central organ in itself. If, when cut out and whole, it is sufficiently excited by the magneto-electric current, it remains in fixed contraction after the current is interrupted; a condition which never happens in muscles separated from their centres, or in separated portions of the heart itself; for in these the contraction ceases with the stimulus.

5. Central organs modify the motor stimuli passing through them, and are thereby regulators of movements, [the *contractions* hitherto mentioned are states of fixed cramp-like contraction; the *movements* here named are movements of alternate contraction and relaxation]. For direct stimuli through the motor nerves always produce fixed contraction of their several muscles; but if the same motor nerves be acted on by reflected stimuli, then (even though these stimuli be continuously applied to the incident nerve, as by the magneto-electric current) *movements* of the muscles ensue, and these with order and an appearance of purpose. The replacement of the cramp-like contractions by the orderly movements in such a case, can be accounted for only by the intervention of the central organ through which the stimulus acts upon the motor nerves.

6. The heart, stomach, and intestinal canal possess central organs, a por-

* Archives de Physiologie, Janv. 1846.　　　　† Müller's Archiv, 1845, No. 5, p. 407.

tion of whose centripetal fibres lie in the vagus, the spinal cord, and the chain of the sympathetic. For when any of these parts of the nervous system is included in the magneto-electric current, there is no contraction of the heart, stomach, or intestines ; whence it follows that neither their nerve-fibres nor their centres are directly stimulated in the experiment.* But orderly movements of alternate contraction and relaxation do, in this experiment, ensue in them ; these, therefore, in accordance with the fifth rule, must be reflex movements, regulated by the nervous centres of the several organs, to which centres the stimuli were conveyed by fibres going to them from the vagus, sympathetic, or spinal cord.

PHYSIOLOGY OF PARTICULAR NERVES. *Third Nerve.* Among these experiments by Volkmann, are some† which show that when the third nerve is stimulated by the magneto-electric current, the voluntary muscles of the eye are thrown into contraction, which ceases on the instant of withdrawing the stimulus, while the contraction of the iris is sometimes prolonged beyond that time. In the voluntary muscles, the contraction indicates that they were stimulated directly through their nerves ; in the iris it indicates a stimulus received by it through a centre ; and Volkmann suggests that the difference is explicable only by supposing that there are in the trunk of the third nerve fibres which convey centripetal impressions to the ophthalmic ganglion, as to a centre from which the stimulus is conveyed to the nerves of the iris.

Fifth Nerve. Two interesting and well-observed cases of paralysis of the fifth nerve on the left side are recorded by Mr. Dixon.‡ In one (a woman fifty-three years old) there was (on the paralysed side) loss of motion in the muscles of mastication, and loss of common sensation in the conjunctiva, Schneiderian membrane, tongue, and skin of the face, except near and about the angle of the jaw. There was also complete loss of taste on the edge and forepart of the left half of the tongue, though on all other parts of the tongue the sense was perfect ; and on the same side, there were loss of smell, partial loss of hearing, impaired vision, and cessation of the flow of tears while weeping at the other eye. Subsequently, the paralysis involved the third, and perhaps the optic nerve, of the same side. In the other case, the losses of nervous power were similar, but they were complicated by neuralgia of some of the branches of the fifth, and by inflammation (perhaps connected with the paralysis) of the conjunctiva, cornea, and other parts of the left eye. [In regard to the question whether the sense of taste be perceived through the fifth, or the glosso-pharyngeal nerve, these cases, like several others, are less decisive than at first they seem ; for in those parts of the tongue in which the fifth nerve is distributed, it may only supply, as it does in the eye and the nose, a certain condition which is necessary in order that the special sense may be exercised through a special nerve. Even the facial nerve appears to have an office in the tongue essential to the sense of taste ; yet it is not itself the nerve of taste].

M. Marchal (de Calvi)§ has related five cases, in which paralysis of the third nerve followed neuralgia of the fifth. One patient had diplopia without apparent deviation of the globe, which ceased on compression of the external frontal nerve. In two of the cases, the neuralgia followed a wound of a branch of the fifth nerve.

Facial Nerve. Under the title of the ' Anatomy of the Geniculate Ganglion,'

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* In experiments by E. H. Weber (Arch. Gén. de Physiologie, Janv. 1846), it is said that the heart ceased to beat on strongly electrifying the pneumogastric nerves, and that its action was weakened and retarded when the stimulus of the nerves was less.   † L c. p. 426.

‡ Medico-Chirurgical Transactions, vol. xxviii, p. 373.

§ Bull. de l'Académie Royale de Médecine, 15 Oct. 1845.

Dr. Morganti* has published a long and important monograph on the facial nerve. He insists on the distinction of its two roots, reckoning as one the small fasciculus, the *portio intermedia* of Wrisberg. He traces, as Malacarne did, the principal root into the substance of the medulla oblongata, in which it at once divides into two fasciculi, one ascending, the other transverse. The first of these fasciculi is composed of longitudinal fibres, which seem to descend from the lateral tract of the medulla oblongata into the nerve; the second, or transverse, is composed of more numerous fibres, and looks like the continuation of the principal root of the nerve; it passes through the substance of the lateral tract, and is directed to its posterior surface, towards the median line of the floor of the fourth ventricle, where it meets its fellow of the opposite side, and is covered by the expanded gray substance of the cord.

The smaller root, or *portio intermedia*, may be traced to the external part of the posterior [restiform ?] tract of the medulla oblongata, in which it connects itself with the filaments of the vestibular branch of the auditory nerve, arising from the substance of the restiform body, where it combines to form the crus cerebelli.

By the aid of nitric acid and very careful dissection, Morganti has unravelled the communication between the trunk of the facial, this *portio intermedia*, and the vestibular division of the auditory nerve. The *portio intermedia* gives off a small branch, which unites with one from the vestibular, and in union with it enters the vestibular nerve. Then, next, it gives off two slender branches, which join the chief trunk of the facial, and cannot be traced further. Then an appearance of a plexus is produced by a branch being given off from this chief trunk, which branch crosses in front of the *portio intermedia*, and then winds behind it, looking just as if it were given to the *portio intermedia* and to the geniculate ganglion, but really passing them and rejoining the trunk. By separating this branch, it is shown that the geniculate ganglion is formed exclusively on the fibres of the *portio intermedia*, and has only a connexion of contiguity with the trunk of the facial. Further, it appears that the geniculate ganglion gives origin—1st, to the superficial petrosal nerves, (to the greater of which is added a small branch or two from the trunk of the facial); and, 2d, to two or three descending branches. These descending branches appear to join the knee-shaped bend of the trunk of the facial, but being unravelled they separate into—1st, numerous small branches forming a kind of plexus and then joining the main trunk of the facial ; and, 2d, the chorda tympani, which the author holds, is thus formed from the *portio intermedia*, with the addition of one or two small branches from the trunk of the facial.

The author confirms this account by evidence from comparative anatomy ; and he draws from the whole the conclusion that the geniculate ganglion (for the truly ganglionic nature of which he gives sufficient proofs) is to be classed with the ganglia on the posterior roots of the spinal nerves. In accordance with this view also, he holds that the facial is a mixed or double-rooted nerve, analogous to the fifth and spinal nerves ; that the trunk (as it is here called) is its anterior root, and the *portio intermedia* its posterior root ; that the superficial petrosal nerves are mixed branches, chiefly composed of fibres going from the facial to the spheno-palatine and otic ganglia ; the chorda tympani, a mixed branch from the facial to the lingual branch of the fifth ; and that, after the formation of the geniculate ganglion, the trunk and branches of the facial contain both sensitive and motor fibres continued from its roots.

The author opposes, in detail, all the objections to these views ; and in answer to the belief that the trunk of the facial is insensible till it is joined by branches from the pneumogastric and fifth, and that the chorda tympani is

* Annali Universali di Medicina; Giugno, 1845.

composed of motor fibres exclusively, he adduces experiments. In many instances he divided the trunk of the facial directly after its exit from the stylo-mastoid foramen, (at least two inches further back than Panizza did); and in every one, acute pain was produced both by the division and by the irritation of the central portion of the trunk. The experiment was performed on horses, asses, dogs, and a sheep; and he shows reason for believing that the pain was not due to anastomoses of the fifth with the facial previous to its exit from the skull; though he admits that some of it might be due to the anastomosis of the auricular branch of the pneumogastric. In many other experiments he irritated the chorda tympani, (which he exposed through the posterior wall of the tympanum), and every time he did so the animal gave signs of pain.

M. C. Bernard* has added four cases of paralysis of the facial nerve, attended by impairment of taste, to those five cases which he published in 1843.† Dr. Guarini's experiments, showing that this is the motor nerve of the lingualis muscle, were noticed in the Report for 1842-3. M. Bernard‡ showed the same by experiments at nearly the same time as Dr. Guarini; and Dr. Verga§ corroborated them somewhat later: so that this fact may be considered certain. To prove the influence which the chorda tympani thus distributed in the lingualis muscle exercises upon the sense of taste, M. Bernard adduces these nine cases of disease of one of the facial nerves in men, and many experiments on animals. In all these, the taste of the corresponding side of the tongue was impaired; the flavour of quinine, citric acid, and other strong substances was very slowly and slightly perceived, while on the other side of the tongue the perception of them was instant and acute. He shows that this impairment is from the paralysis of the chorda tympani, by cases in which the cause of paralysis of the facial nerve being seated in front of the giving off of the chorda tympani, the taste was not impaired; and by experiments in which the facial being divided behind the part where the chorda tympani is given off, the sense was destroyed. By this last experiment, in which no injury could be done to any filaments of the Vidian that may join the facial, and by other experiments, which show‖ that the chorda tympani is insensible, he makes it clear that the influence which the chorda tympani has on the sense of taste cannot be due to branches of the fifth nerve transmitted by the Vidian to the facial. Neither can the loss of taste be due to the dryness of the side of the tongue, for it is as moist as the other side. His own explanation is, that the papillæ of the tongue are rendered incapable of the vermiform movement by which they absorb the sapid particles, and bring them into contact with the gustatory nerve [a notion at least as improbable as any that his facts disprove].

In none of these four cases by M. Bernard was there any deviation of the uvula. They may, therefore, seem to confirm the evidence from Dr. Hein's¶ experiments that the facial does not send branches to the muscles of the palate or uvula.

But it is not certain that in these cases the seat of the disease of the nerve was behind the connexion of the petrosal nerves with it; and, if it were not, the muscles of the palate might be unaffected, though all the others supplied by the facial were paralysed. Notwithstanding these cases, therefore, and although Valentin** also has failed to excite movements of the palate in either the horse, dog, cat, or rabbit, by irritating the trunk of the facial nerve, yet, on the whole, I think the evidence is in favour of the opinion that, at least in man, the facial nerve sends filaments through the great superfical petrosal

* Archives Gén. de la Méd., Decembre, 1844.   † Annales Medico-physiologiques, Mai, 1843.
‡ In the Inaugural Thesis of M. Pomies, Paris, 1842.
§ Gazetta Medica di Milano, Giugnio 24, 1843.
‖ According to Morganti, this is wrong; but the experiment is not essential to the conclusion.
¶ See last Report.   ** Lehrbuch der Physiologie, ii, p. 673.

nerve to the spheno-palatine ganglion, and thence to the levator palati and levator uvulæ.* It is impossible otherwise to explain the deviation of the uvula, which is often seen when the facial nerve is paralysed. The absence of contraction of the palate-muscles when the nerve is irritated may be connected, as M. Longet suggests, with the filaments having to pass through a ganglion ; in the same manner as irritation of the third nerve often fails to produce contraction of the iris.

Pneumogastric Nerves. Signor Poletti† shows that the removal of portions of both these nerves in the horse, sheep, and rabbit does not diminish the impression of the necessity of breathing. There is the same struggling for breath when the respiration is in any way hindered as there is while the nerves are entire ; and if the animals, after division of the nerves, are put in an exhausted receiver, their anxiety for air is as great as when the nerves are not divided. In sheep, the glottis remains open though both the recurrent nerves are paralysed by the division of the pneumogastric nerves, and they breathe easily till the air-passages are obstructed by frothy fluid, or till the nostrils are purposely held close ; then there ensues extreme dyspnœa. There were the same anxiety and dyspnœa when, after division of the pneumogastric nerves, the spinal cord in a rabbit was divided between the second and third cervical vertebræ ; the diaphragm still acted with great energy. Poletti therefore supposes that, since in this last experiment nearly all the cerebro-spinal incident nerves were separated from the medulla oblongata, the sympathetic nerve must be an important agent in transmitting the impressions of the necessity of breathing.

From some experiments related by M. Dupuy‡ it would appear that in a few minutes after the ligature or division of the pneumogastric nerves, the blood of the carotid artery is black like venous blood, and contains less fibrine than it did before. If the life of the animal be prolonged for about six days by tracheotomy, the respiration becomes difficult, the signs of malignant pustule manifest themselves, and by placing portions of the spleen of such a horse in a wound made in a healthy horse, the disease may be communicated.

From many experiments on dogs, Dr. Mendelsohn§ deduces that the congestion and other disorders of the lungs which follow division of the trunk of the pneumogastric are due, not to the paralysis of the nerves of the lungs themselves, but to that of the branches of the recurrent on which the openness of the glottis depends ; for the same affection ensues whether the recurrent or the pneumogastric trunks be divided. In both cases the glottis is nearly closed in inspiration, and the symptoms are the consequence of the diminished respiration. In regard to the diminished frequency of respiration after division of the pneumogastric, Dr. Mendelsohn says that the very same is observed after division of the recurrent nerves ; and, in either case, may be prevented by the introduction of a tube into the trachea.

The continued irritation of this nerve by the magneto-electric current produces fixed cramp-like contraction of the œsophagus, and movements of alternate contraction and relaxation of the stomach. It follows, according to Volkmann's rules already mentioned, that the stimulus is conveyed to the œsophagus directly, through its motor fibres forming part of the trunk of the pneumogastric, and to the stomach indirectly by a reflected influence. Now, since the removal of the brain and spinal cord does not interfere with this

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* In addition to the evidence for this view in the last Report, p. 52, see the cases concerning the diagnosis of fracture of the base of the skull in the Bull. de Thérapeutique, Mars, 1845 ; and a case of tuberculous disease of the petrous bone, with paralysis of the facial nerve and deviation of the uvula, in the Oesterr. Medic. Wochenschr., 11 Oct., 1845.

† Bullettino delle Scienze Mediche, Luglio, 1844.

‡ Bull. de l'Acad. de Médecine, 31 Oct., 1844.

§ Roser and Wunderlich's Archiv, 1845, Heft ii ; and Oesterr. Medic. Wochenschr. 19 Juli, 1845.

result, it follows that the stomach must have reflecting nervous centres in itself, and that there must be fibres in the pneumogastric nerves which are centripetal in their relation to these local centres.

Accessory Nerve. Volkmann* has repeated his experiments on the motor nerves of the larynx; and, in confirmation of his former statement and that of Dr. John Reid, says, that in numerous experiments he has never once seen movements of the muscles of the larynx follow irritation of the accessory nerves, but has as constantly seen them follow irritation of the pneumogastric. He has also completely divided all the roots of the accessory nerves in a dog, and has seen the movements of the larynx continue unchanged.

But after all the evidence adduced in the last two Reports in favour of the accessory being at least the motor nerve of some of the muscles of the larynx, I cannot think these experiments conclusive against it.

Hypoglossal Nerve. Dr. Stokes† has never, in many examinations, been able to find what Mayer described as the small posterior ganglionic root of the hypoglossal nerve in the ox. He has, however, found that it always has a small root derived from the side of the spinal cord anterior to the roots of the accessory nerve. From this origin the root passes up into the skull, and, without having any ganglion, is united to the lower of the two fasciculi in which the hypoglossal nerve passes through the dura mater.‡

ANATOMY AND PHYSIOLOGY OF THE ORGANS OF SPECIAL SENSE.

Of the Eye. *Vessels and Nerves of the Cornea.* Professor Gaddi,§ of Modena, describes, from a minute injection of the vessels of a child two years old, the vessels of the conjunctiva bulbi as forming a dense circle by numerous angular anastomoses around the border of the cornea. From the angles of union, he says, some very minute vessels are given off, which pass like rays, or like the vessels of the membrana pupillaris towards the centre of the cornea; and, besides these, there pass, from the same angles, many more, which insinuate themselves between the commissure of the cornea and sclerotica, and thus form communications with the vessels of the choroid.

Purkinje,‖ in the series of examinations already often quoted, has discerned, by making the cornea transparent in acetic acid, a " tolerably rich network of nerves" in it. These fibres variously combine with each other; those entering on one side from the ciliary nerves mingle with those from the other, so that no nerve-fibre appears to be lost in the substance of the cornea, or to pass into the superjacent conjunctiva.

Structure and Movements of the Iris. Some experiments of Signor Guarini¶ would make it probable not only that the movements of the iris are mainly due to two sets of muscular fibres,—one circular, for the contraction of the pupil, the

* Wagner's Handwörterbuch der Physiologie, art. Nervenphysiologie, p. 500.

† Cycl. of Anatomy, art. Ninth Pair of Nerves.

‡ Other recent works of interest on the physiology of the nervous system are—1. J. H. Lenzingar, Die menschliche Nervensystem physiol. bearbeitet; Zurich, 1845, 12mo—Idealistic. 2. K. F. Burdach, Umrisse einer Physiologie des Nervensystems; Leipzig, 1844, 8vo—Outlines. 3. Remak, Neurologische Erläuterungen; in Müller's Archiv, No. 5, 1844, containing, with controversial matter, brief accounts of small ganglia in the nerves in the heart, lungs, and larynx; of the six layers of the cortical substance of the brain ; and of the central fasciculus in the nerve-tubules of the abdominal cord of the river cray-fish:—all according with former descriptions by the author. 4. Romberg, De paralysi Respiratoria; Berlin, 1845, containing the outlines of the physiology of the pneumogastric and its branches. 5. Cowan, Two cases of Carcinoma of the Brain, in the Provincial Med. and Surg. Journal, April 16, 1845. In one case loss of control over the muscles appeared to be owing to implication of the cerebellum : the patient, in walking, deviated to the left side, and the disease affected the left side of the cerebellum and pons, and the left crus cerebri. 6. Bourgery, Recherches sur le Système Nerveux Splanchnique ; in the Gazette Médicale, 3, 10 Mai, 1846.

§ Bullettino delle Scienze Mediche, Nov. e Dicembre, 1844 ; Report from the Società Med. Chir. di Bologna, 30 Ottobre, 1844. ‖ Müller's Archiv, 1845, No. iv, p. 292.

¶ Annali Univ. di Medicina, 1844, and Gazette Médicale, 26 Avril, 1845.

other radiating, for its dilatation,—but, also, that these movements are under the influence of two sets of nervous fibres, of which one set, distributed to the circular muscle, are derived from the third nerve through the ophthalmic ganglion, and the other, distributed to the radiating fibres, are supplied by the branches of the cervical spinal nerves which pass through the superior cervical ganglion of the sympathetic. The experiments show, as Valentin's did, that after division of the third nerve the pupil dilates, and that after removal of the superior cervical ganglion it contracts. In animals killed by strychnine the pupil is dilated; but if, before giving the strychnine, one of the superior cervical ganglia be removed, and the pupil of the same side be thus made to contract, it dilates only a little after the administration of the strychnine, while, in the same case, the pupil of the opposite side is extremely dilated. Again, if one of the third nerves or the ophthalmic ganglion be irritated in a body still irritable, the pupil of the corresponding eye contracts slowly and does not dilate again. But if, after the pupil of a live animal has contracted on irritating the third nerve, the superior cervical ganglion be irritated, the pupil dilates again.

But while these movements of the iris after death and on the irritation of its nerves indicate its muscular structure, Guarini relates another experiment to show that the turgescence of its vessels has also some share in producing or maintaining the contraction of the pupil Thus, he says that the contraction of the pupil, when after death the third nerve is irritated, is never so complete as it is during life; because the circulation having ceased, the congestion of the blood-vessels with which the muscular fibres are interlaced, and which they compress when they contract, cannot take place; but the dilatation of the pupil on irritating the superior cervical ganglion after death is as complete as during life.

Membrana Pigmenti. C. Bruch* describes the numerous round or oval nuclei among the pigment-cells scraped from the choroid, as forming a separate layer between the choroid and the cells of the pigment. Among those taken from the pig's eye, he found many fixed in a delicate, pellucid, structureless membrane; they lie, commonly, in close-set rows, or, more rarely, scattered in the membrane; and some, which have probably been accidentally separated, are found unattached. Bruch has traced this membrane in many animals, and in man, in whom it extends over the whole choroid, the ciliary ligament, and the posterior surface of the iris. Its nature and purpose are uncertain; whether it be only such a basement or germinal membrane as lies beneath the epithelium of mucous membrane in general, or a layer of embryo pigment-cells with cytoblastema, cannot be determined; but, if any part does, this deserves the name of membrana pigmenti.

Tapetum. Ernst. Brücke† has added observations to those which he published last year, to prove that the office of the tapetum is to reflect light, on the staff-shaped bodies of that part of the retina which is most used in vision, and so to make vision possible to certain animals, at times when those without a tapetum are in darkness. He has produced an extensive comparative anatomy of the tapetum; and has shown that while all the other various colours which the tapetum of the dog and other animals presents in different lights depend on it alone, the red colour which it occasionally reflects is due to the large vessels beneath it coming into view. And he has discovered that there are in different animals two distinct kinds of tapetum,—the one *fibrous,* the other *cellular.* The fibrous tapetum, which has been long known to consist of smooth, transparent, undulating fibres, is found in ruminants, solidungula, the elephant, some marsupials, and the whale tribe. The cellular tapetum, hitherto unknown, is found in the carnivora and in seals. The cells, which may be best seen after pieces of tapetum have been macerated for a day or two in water with some hydrochloric acid or alcohol, are smooth, nucleated, elongated, unequally and imperfectly hexagonal, and very large, measuring from ·0008 to ·0028 of an inch in diameter.

* Untersuch. zur Kennt. des körnigen Pigments der Wirbelthiere; Zurich, 1844, 4to, p. 6.
† Muller's Archiv, 1845, Heft iv, p. 387.

With transmitted light they appear yellowish, and their nuclei pellucid ; but with reflected light, they are beautifully blue and their nuclei black. They are peculiarly subject to deposits of earthy matter.

Retina. Pacini[*] has described the retina as consisting of five layers. The first or most internal is formed of the expansion of the white double-contoured (?) fibres of the optic nerve, lying close together in a transparent layer. The second is a single layer of nucleated and nucleolated transparent corpuscles, like simple ganglion-corpuscles, which he calls nerve-cells. The third, of a reddish-yellow colour, consists of gray nerve-fibres arranged in rays, which terminate in the cells of the second layer. The fourth is composed of several layers of corpuscles, identical with those described by Ehrenberg in the cortical substance of the brain and in other parts of the nervous system, and called by Pacini, from their nuclear characters, nuclear nerve-corpuscles. The fifth layer is formed by the little cylinders of the membrane of Jacob [the staff-shaped bodies of others]. Of these layers, the 1st, 4th, and 5th cease at the ciliary ligament ; but the 2d and the 3d, as if forming together a true ganglionic system, appear to be continued over the ciliary processes and iris.

Lens. Sundry observations on the structure of the lens are published by Professor Harting.[†] Among them are the following. In both the new-born child and the adult he finds some of its flat fibres composed of rows of cells fixed end to end ; and some having in or on their walls distinct round or oval nuclei, each with two or three very small irregular nucleoli. Both these kinds of fibres are found only at the equator of the lens, in which part they form the outermost layer. Neither the deeper layers at this part, nor the superficial layers near the poles, present a trace of such fibres. The lens of the new-born child has many more of the fibres with nuclei than that of the adult has.

In the lens of a cow, just beneath the surface, and in that of a titmouse (Parus major), near its nucleus, he found some of the fibres composed of from five to seven finer parallel fibrils ; and in other fibres near the surface of the lens of the titmouse, there were transverse striæ, which (like Wagner, who has also observed such fibres) he compares to those of the primitive fibres of muscle.

Vitreous Humour. Ernst Brücke[‡] has confirmed the account which he gave of the laminated structure of the vitreous humour by another mode of demonstration. If an eye, frozen hard, be slowly thawed, and the sclerotica and other membranes be separated gently as soon as they are soft enough, lamellæ of ice may be split off from the vitreous humour, exposing the layers of membrane of which it consists, the outer layers being parallel to the retina, the inner to the posterior surface of the lens ; and all apparently structureless.

A more exact account of the structure of the vitreous humour is rendered by Hannover.[§] He has examined it principally and with most advantage in the eyes of horses, hardened in chromic acid, so that sections in various directions could be made through them. By these means he has cleared up a doubt which Brücke's essay left, by finding that the several layers which compose the vitreous humour all form completely closed sacs, the outer sacs inclosing the inner, and all imitating the general form of the front of the eye behind the lens. Thus, in its laminated arrangement, the vitreous humour somewhat resembles a bulb, and the shape of its layers or sacs is such, that a line drawn from the middle of the optic nerve to the middle of the posterior wall of the lens would pass through the apices and the middles of the convex bases of them all.

On this same plan of concentric sacs of delicate membrane are formed the vitreous humours of the cat, dog, ox, sheep, and horse. But the human vitreous

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[*] Atti della sesta Riunione degli Scienz. Italiani, in the Ann. Univ. di Medicina, Luglio, 1845.

[†] Tijdschrift voor Natuurl. Geschied. en Physiol., 1845, d. xii, st. 1. His account of the growth of the lens is mentioned under the head of Nutrition.

[‡] Muller's Archiv, 1845, Hefte ii, iii. For his former account, see the last Report, p. 57.

[§] Ibid. 1845, Heft v. There is in the same journal a paper by him on the arrangement of the fibres of the lens ; but his description could not be understood without diagrams.

humour is differently constructed; it consists of sectors, all with their arcs directed outwards, and their angles converging to the axis of the eye. Its structure may be best compared with that of an orange, sections of which in various directions will display the various appearances which are seen in different sections of the human vitreous humour. In the axis of the eye, to which the angles of all the sectors of the vitreous humour converge, is the hyaloid canal, the passage which is open in the child for the arteria centralis retinæ; but the angles do not reach this canal; the substance next to it is uniform and textureless, as if all the sectors had become very thin, and had coalesced. The number of rays which may be seen diverging from this central part, and which represent the number of sectors, is about 180; the width of the arc of each sector is about one sixth of a line. It is not certain whether each sector has its own walls, or whether one wall serves for two. Whichever it be, these walls may be described as lamellæ of pellucid structureless membrane, extending from the tunica hyaloidea in rays towards the axis of the eye, and forming a kind of membranous skeleton for the more fluid part of the vitreous humour.*

Relation of non-luminous Rays to the Eye.—To determine why those rays which, after dispersion by the prism; are beyond the spectrum (the so-called chemical and calorific rays of light), do not produce on the eye the sensation of light, and to determine whether the retina is insensible to them, or they are hindered from reaching it, Ernst Brücke† has instituted some simple and very interesting experiments. The colour obtained from guaiacum wood is changed to a dark blueish-green on exposure to diffused light, the change being effected by the chemical rays,—those beyond and just within the violet. But if part of a surface tinged with the original colour be so screened that the light can pass to it only through an ox's or other animal's lens, the colour of this part is hardly changed. A part similarly screened, but having light admitted to it through a cornea, is only a little more changed; by light admitted through vitreous humour, yet a little more; and if to this screened part the light be made to pass through both a cornea and a lens, then, while all the rest of the surface undergoes the usual complete change of colour, this remains often unchanged, and is at most changed in only the slightest degree; so that it appears that the transparent parts of the eye absorb the chemical rays of light before they can reach the retina, and that therefore they are invisible.

Another set of experiments was directed to determine the relation of the calorific rays (those beyond and just within the red) to the same parts of the eye. These also appeared to be completely arrested; rays of light passed freely through the cornea and lens, and fell upon a thermo-electric apparatus; but its needle remained immoveable, as if the whole of the heating rays were absorbed.

Ear. *Movements of the Ossicula.* Eduard Weber‡ has found that the articulation of the head of the malleus with the incus is such, that when the malleus is moved with the membrana tympani, it cannot move upon the incus; but the two bones always move together, as if they were one bone. Their axis of movement is the line drawn from the slender process of the malleus to the lesser process of the incus, so that the membrana tympani impresses the movement on the malleus and incus, and these turn, as on a pivot, on the two processes adhering to the wall of the tympanum. Thus, when the membrana tympani is carried inwards, the stapes is pushed within the fenestra ovalis by the long process of the incus; and when the membrana tympani is carried outwards, the stapes is moved out from the fenestra ovalis.

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* Hannover's attention was first directed to this structure of the human vitreous humour by a morbid examination of the appearance of its structure in two congenital cases of colobama, which are described in the same number of Muller's Archiv, p. 482.

† Muller's Archiv, Hefte ii, iii, 1845.

‡ Archives de Physiologie, Janvier, 1846; Report from the Naples Congress, 1845.

Hence appears the utility of the fenestra rotunda for the movements of the stapes. For the stapes could not thus move if the cavity of the internal ear was bounded by unyielding walls, since the fluid within it is hardly compressible. But as the fluid of the vestibule communicates with that of the cochlea, especially with that of the scala vestibuli, which again freely communicates with that of the scala tympani, so when the membrane of the fenestra ovalis is pushed inwards towards the vestibule, the membrane of the fenestra rotunda will be pushed outwards; as it is always seen to be after death in such a case. And thus the movements of the membrana tympani produce indirectly the flux and reflux of the fluid of the labyrinth, from the fenestra ovalis to the fenestra rotunda, by percussion and by the yielding of the lamina spinalis of the cochlea.

TONGUE. *Structure of its Papillæ.* A new and very interesting account of the papillæ of the tongue is given by Dr. Todd and Mr. Bowman.[*] They have found that all those hitherto described as simple papillæ, appearing different by being variously grouped, are really compound organs; i. e. they are papillæ clothed with secondary, simple, and much more minute papillæ, which are concealed under the epithelial investment, and are scarcely or not at all visible till it is removed. They have also discovered minute simple papillæ, hitherto unknown, which are unequally dispersed among the compound ones, and occupy much of the space at the base of the tongue behind the circumvallate papillæ. The epithelium covering these makes the surface appear quite smooth; but when it is removed, they are seen prominent, each having an envelope of basement membrane, and receiving a capillary loop like those which pass into the simple papillæ of the skin. Papillæ like these compose the papillæ circumvallatæ. The surface of the fungiform papillæ is clothed with secondary simple papillæ, each of which receives a capillary loop from the more complex arrangement of vessels within the primary papillæ. The filiform and conical papillæ also are compound, being variously beset with fine acuminated secondary papillæ, more stiff and elastic than the others. The epithelium, also, of these papillæ (while that of the fungiform papillæ is very thin) is so thick and dense, that they appear white; it is also sent off from their surface in many fine hair-like processes, more or less stiff, or is arranged in variously imbricated scales, within which there are in some cases real minute hairs[†] pointed at the end, and having extremely fine central canals. Their structure sufficiently indicates that these papillæ are subservient to mastication rather than to taste.

STRUCTURE AND FUNCTIONS OF THE ORGANS OF GENERATION.

Nerves of the Male Genital Organs. According to Purkinje,[‡] fine-fibred nerves existed in the tunica albuginea in the neighbourhood of the epididymis. Many such, also, accompany the arteries of the penis. A rich network of large cerebro-spinal nerve-fibres exists in the fibrous tissue of the penis; and fine-fibred nerves with little ganglia may be found, but with difficulty, in its spongy tissue.

Processus Vaginalis in the Female. Professor H. Meyer § has described, and confirmed therein the accounts of Camper and some others of the older anatomists, the processus vaginalis of the peritoneum in the female fœtus. Its position and arrangement are exactly analogous to those which it has in the male.

Maturation of Ova; Menstruation. Two cases of apparent discharge of ova at the menstrual period are recorded by M. Serres.[||] The ovum could not be seen in either, but in both, Graafian vesicles were found recently burst and very vascular.

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* Physiological Anatomy and Physiology, vol. i, p. 435. The beautiful figures illustrating these structures describe them better than words can.

† The existence of these minute hairs guides at once to the explanation of the seemingly strange cases in which large tufts or coats of hair have been found on the tongue. See some such cases recently related by M. Landouzy in the Bull. de l'Acad. Roy. de Médecine, 15-30 Dec. 1845.

‡ Muller's Archiv, 1845, Heft iv, p. 293.   § Ibid. Heft iv, p. 363.

|| Comptes Rendus, 18 Novembre, 1844.

Dr. Schweig[*] having ascertained in 60 women the length of interval between 500 occurrences of menstruation, finds that the mean length of the interval is 27·39 days; and that therefore the periodicity of menstruation corresponds, not with the phases of the moon, (for the lunar month marked by these is, on an average, 29·53 days); but with the nodes of the moon, the period from one of these to another of the same kind being 27·56[†] days.

Dr. Guy's[‡] tables, made from observations of 1500 women, show that 15 years is the age at which the greatest number of women (English, I suppose) first menstruate; that the 14th year comes next in order, then the 16th, and that the 13th and 17th, 12th and 18th, 11th and 19th, present numbers which are succes· sively less, but respectively nearly equal. Of the 1500, 791 first menstruated at 14, 15, or 16. Of 400 women, 159 ceased to menstruate between 45 and 50; 140 between 40 and 45; 51 between 35 and 40; 41 above 50; and 9 under 35. As a general rule, also, it appeared that the earlier menstruation begins the longer it lasts.

Mr. Roberton,[§] continuing his researches into the question of the age at which women in different climates begin to menstruate, has obtained information from Moravian missionaries on the coast of Labrador, which proves that among the Esquimaux of that region the average period of first menstruation is the same as in this country. The fecundity of the Esquimaux women is also shown to be not less, but considerably greater, than that of the average of English married women; neither, since the introduction of Christianity among them, have early marriages been frequent.

He has also obtained tables[||] showing the average ages of puberty and first conception among Hindoo women. Among 71 at and near Bangalore, the average age at which menstruation first took place was 13 years and 2 months; the average age at the birth of the first child was 16 years and 5 months. Similar tables have been constructed for native women of Bengal, living in and néar Calcutta, by Bábu Modusooden Gupta and Dwarkanath-das Bosu, the Demon- strator and Curator of the Calcutta Medical College.[¶] In 152 women the ave- rage age at first menstruation was 12·48 years; two of these first menstruated when 8 years old; 2 when 9 years old; 2 when 17; 1 when 16. In 93 of these women the average age at which the first child was born was 14 years and 8 months; in 1 case only at 10; in 6 at 11 years; in 1 at 30; in 1 at 19; in 2 at 18. Yet the general result of the inquiries, though they show so early a period of puberty, is not wholly unfavorable to the opinion of Mr. Roberton, that the early puberty is the consequence of early sexual excitement; for girls are always given in marriage before their first menstruation, and it is customary to send them at as early an age as nine years to the houses of their husbands; and it is stated that if distance hinders this, menstruation is generally delayed till the 13th year. Some analogous instances of early fecundity brought on in animals by premature sexual intercourse are mentioned by Dr. Berthold.[**] Among them is one of a kid only fourteen days old which was impregnated by an adult goat; at the end of the usual period of gestation it bore a kid, mature, though very

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[*] Gazette Médicale, 2 Août, 1845; from Roser and Wunderlich's Archiv für Phys. Heilkunde, Heft ii, 1845.

[†] So it is said in the original; but this period of 27·56 days is more nearly equal to the length of the *anomalistic* month of 27·5546 days, marked by the successive revolutions of the moon from perigee to perigee. The average interval between two menstrual periods, 27·39 days, is more nearly equal to the average length of the sidereal month, or 27·3216 days, in which the moon makes the complete circuit of the heavens. The true length of the nodical month is not 27·56 days, but 27·212 days. See Baily, Astronomical Tables.   [‡] Medical Times, Aug. 9, 1845.

[§] Edinburgh Med. and Surg. Journ., Jan. 1845.   [||] Ibid. October, 1845.

[¶] India Journal of Med. and Phys. Science, February, 1845.

[**] Ueber das Gesetz der Schwangerschaftsdauer; Göttingen, 1844, p. 32. The accounts of the physiology of menstruation, by Raciborski and others, are examined by Dr. Alexander, in Oppen- heim's Zeitschrift f. d. ges. Medicin, Dec. 1844.

weak, to which it gave milk, and which grew up healthy and strong. The young mother gave more than milk enough for its kid, grew up to full size and strength, and twice afterwards had kids.

Processes following the Discharge of Ova ; formation of Corpora Lutea. Dr. Dubini* has carefully examined the ovaries in the bodies of many women, and has found—1. That in those who have never menstruated the ovaries have never shown any trace of cicatrices ; but in those who have menstruated, cicatrices were never absent. 2. That in a few cases the ovaries of women who had been recently [but how recently ?] delivered presented no corpus luteum. 3. That the number of the so-called old corpora lutea, i. e. of vesicles with thick opaque white walls, and deeply wrinkled, which are found in the ovaries of different women, bears no relation to the number of children they have borne.

M. Raciborski† states that in regard to the formation of these bodies, which he supposes to consist in the " concentric hypertrophy" of the internal or granular membrane of the Graafian vesicle, there are characteristic differences between the females of the human species and of other mammalia. In the cow, ewe, doe, &c., the corpora lutea begin to be formed directly after the expulsion of ova, and they are just the same, whether the ova are impregnated or not ; they are always genuine true corpora lutea. But in women, if the ovum expelled at any menstrual period is not impregnated, the *hypertrophy* of the internal layer of the vesicle is soon arrested, and it remains a thin yellow membrane in contact with the more or less altered clot of blood. If it is impregnated, the consequent process is different, but in degree only, not in kind ; in this case the hypertrophy goes on, till very shortly the cavity of the vesicle is almost completely filled by the accumulated substance. And in this admission of the differences between the corpora lutea, according as the ova are impregnated or not, Berthold ‡ agrees ; holding, I think, that the purpose of the development of the true corpus luteum is that a process may be going on in the ovary which may exclude the ordinary maturation and discharge of ova during gestation.

Some elucidation of what is thus roughly, though correctly, described as hypertrophy of the inner membrane of the Graafian vesicle, is afforded by the inaugural dissertation of Dr. Zwicky,§ who has minutely examined the formation of corpora lutea in cows and sows. The general results of his investigations may be thus briefly stated :—at the period of heat, when the ova are about to be discharged, the Graafian vesicle becomes more vascular and enlarges ; serum is more abundantly secreted into it, and its membranes thicken. The cells also, part of which form the granular membrane of the Graafian vesicle, while part float in its fluid, are changed before the exit of the ovum. Flocculi appear in the fluid, and vascular folds and villi on the inner surface of the vesicle, which all consist of the altered cells. Some of the cells are changed by elongation into small narrow fibrous cells, which at last become fibres of imperfect fibro-cellular tissue ; and others are changed into larger round or ovate cells, which also, unless they burst, are ultimately changed into similar fibres. And again, some other cells become four, or five, or even ten times as large as they were, and very finely granular ; their nuclei also become larger and clearer, and their nucleoli more evident. Their enlargement appears to depend on the accumulation of the little fat-granules which the Graafian vesicles always contain. As they increase they pass from the round or ovate, into the oblong or acuminated form. The fat-granules and other fatty particles are those in which the yellow colour of the corpus luteum, when it exists, is contained.

When the ovum is discharged through the ruptured Graafian vesicle, blood is

* Annali Univ. di Medicina, Febbr., 1845, p. 277.
† Report from the Acad. des Sciences ; Gazette Médicale, 23 Nov. 1844.
‡ Ueber das Gesetz des Schwangerschaftsdauer ; Göttingen, 1844, p. 17.
§ De Coporum Luteorum origine atque transformatione ; Turici, 1844, 8vo.

effused into the cavity, in the sow, but not, according to Zwicky, in the cow. The blood about half fills the enlarged cavity. After it has coagulated, it becomes gradually more solid, being compressed by the wall of the vesicle, which is both growing thicker and contracting. Thus compressed, and encroached on by the increasing and enlarging cells of the interior wall of the vesicle, the clot at last disappears, having, it would seem, contributed little to the formation of the corpus luteum.

The wall of the vesicle, after the exit of the ovum, is from half a line to two thirds of a line in thickness, and it continues to increase inwards by a continuance of the same process of multiplication and enlargement of its cells as preceded the discharge of the ovum, till, at length, the cavity of the follicle is completely filled. While it is thus increasing also, one portion of its fibrous cells are combined in fasciculi of connective or fibro-cellular tissue, which, traversing the whole mass, hold it together, and support the blood-vessels which run through it; and another portion are placed promiscuously between and among the large round cells. As soon as by this growth of the inner membrane of the Graafian vesicle its cavity is filled, its period of involution or degeneration begins; it grows smaller, more solid, and dries. In this change, some of its large round or ovate cells become narrow, and assume the appearance of fibres; and the longest, which are not thus changed, burst, and probably are absorbed with their contents.

The corpus luteum in this process of involution consists of only fibrous cells in various stages of development, and a large abundance of fatty matter. The fibrous cells become narrower, and their nuclei being drawn out, the whole gradually puts on the appearance of uniform slender cylindrical fibres, like those of immature fibro-cellular tissue. By these the walls of the Graafian vesicle are thickened, or else, as in cows, the fibres after a time coalesce with the stroma of the ovary, and can no longer be separated from it. And the end of the corpus luteum is, not that it is absorbed, but that it is lost sight of when this transformation of its component cells into fibrous tissue, like that of the stroma of the ovary, is complete.

Gestation. Dr. Berthold* estimates that parturition after healthy gestation takes place when the ovary, having omitted during pregnancy the maturation of nine menstrual ova, is preparing for the maturation and discharge of what, in the unimpregnated state, would have been the tenth. The proper period of gestation† will thus be equal to the interval comprised between the beginnings of ten menstruations, *minus* from ten to fourteen days. The above-named interval will not be always the same, while in different women, and in the same, under different circumstances, the intervals between the successive menstruations vary; but it may be estimated as equal to the number of days which intervened between the beginnings of the ten menstruations before the pregnancy. On an average this period will be between 290 and 300 days; the ordinary period of gestation will therefore be between 280 and 290 days; but it may be as short as 273, or as long as 291 days, in those whose habitual periods are shorter or longer than usual. In those whose menstrual periods are very short, parturition may take place at the eleventh instead of the tenth period.

Dr. Berthold's evidence for his mode of calculation is, 1st,—in a few cases in which it has proved true; 2d, in an apparent analogy in the case of cows and

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* Ueber das Gesetz der Geschwangerschaftsdauer; Göttingen, 1844.

† This expression is not correct, because gestation is not begun till impregnation has taken place. The calculations are here made as if gestation began on the first day of a menstruation; but impregnation may take place some days (probably not less than twelve) after that day, or perhaps a short time before it. If, however, this mode of calculation is so correct, that the knowledge of the day of impregnation is unimportant, we must certainly admit Dr. Berthold's theory, that parturition is determined, not by the age or state of the child, or by the state of the uterus, but by that of the ovary, when it is reassuming its periodical action after its inaction of nine of its ordinary periods; a theory supported by the fact that, in pregnant animals, removal of the ovaries always produces abortion, but great injury of the tubes has no such effect.

sheep, in whom parturition occurs a little before the day on which the tenth heat-period would have fallen, if they had not been impregnated ; 3d, in more distant analogies of some other periodic processes, such as the shedding of teeth and horns ; 4th, the possibility of impregnation taking place in both women and animals within a few days after delivery ; the ovum thus impregnated being probably that for the maturing of which the ovary was in preparation when parturition ensued ; 5th, the apparently similar condition of the ovary shortly after delivery and shortly before the time of heat or menstruation.

Delivery. It is reported by Dr. Schultze,* of Spandau, in which a woman was naturally delivered of a full-grown child during a three-days' deep sleep. She passed into the sleep without premonitory signs, and awoke from it spontaneously on the day after her delivery.

Lactation. M. Dumas† has observed a constant difference between the milks of the truly carnivorous and the herbivorous animals, in that in the former the sugar of milk is either absent or exists in quantity too small to be extracted. But as soon as carnivorous animals (as bitches) are fed with bread or other amylaceous food, sugar is formed in the milk : and it disappears when their food is again made exclusively of animal principles. The casein of the milk of bitches is similar to that from the herbivora.

According to Dr. John Davy,‡ the coagulability by heat of the colostrum of the cow is due, not to its containing albumen, but to a peculiar modification of casein in it. Its nutritive matter is more concentrated, it is more easily coagulated by rennet, and it is less readily changed by the action of atmospheric air than the later milk is. The human colostrum (according to the examination of a few specimens) is not peculiarly rich in nutritive matter, neither does it coagulate on being heated.

The constitution of the milk of a male goat, determined by Dr. Schlossberger,§ shows that it *is* milk, and that it is richer in casein, but poorer in butter and sugar of milk, than cow's milk is. The secretion of milk by he-goats is said to be not rare ; the one from which the samples analysed were obtained, was four years old, and had male genital organs, perfect in both structure and function.

* Medic. Zeitung, No. 31, 1844 ; and Oester. Med. Wochenschrift, Dec. 14, 1844.

† Report from the Acad. des Sciences, Gazette Médicale, 4 Oct. 1845 ; and in the Ann. des Sciences Naturelles, Sept. 1845.

‡ Medical Gazette, April, 18, 1845 ; and Medico-Chirurgical Transactions, vol. xxviii, 1845.

§ Müller's Archiv, 1844, Heft v, p. 439. See also notes on similar cases by M. Isidore Geoffroy St. Hilaire, in the Comptes Rendus, 18 Août, 1845.